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ABSTRACT

This collection of 18 papers covers four broad areas of teaching and learning in higher education: innovative college teaching/learning strategies; effective classroom research/assessment activities; advanced classroom technology; and developing teaching and learning centers. Titles include: (1) "African American Students' Perceptions of Cooperative Learning Experiences" (Lillie Anderton-Lewis and Danny H. Pogue); (2) "Learning to Learn Is a Teachable Skill" (Joan B. Baker, et al.); (3) "The Florida Higher Education Consortium: A Mathematics, Science, Technology Collaboration" (Marianne Barnes, et al.); (4) "Directions in the Core Curriculum for Computer Science Majors" (Edward J. Conjura); (5) "Teacher Immediacy and Distance Learning: The Multicultural Dimension" (James M. Cunningham and Mary McLemore); (6) "Liberal Education in Technology Courses" (Diane Delisio and Cathy Bishop-Clark); (7) "Learning and Motivation Theory Applied to Instruction" (Paul Eggen); (8) "Bringing the New Technologies to Distance Learning: A British Perspective" (Joel Greenberg); (9) "A Model Program: Discipline-Specific Instruction for Graduate Teaching Assistants" (Penny L. Hammrich and Kerri Armstrong); (10) "Is Technology a Substitute for Preparation in Calculus I?" (Robert Jerrard, et al.); (11) "Science Teacher Preparation: Whose Knowledge Is It?" (Judith Johnson); (12) "Learning to Teach on Television: Implications for Beginners" (Norma MacRae and Darcey Cuffman); (13) "Integrating Science and the Humanities: Redefining the Preparation of Elementary Teachers" (Patricia A. Nelson); (14) "Will Success Spoil Distance Education?" (Leslie Purdy); (15) "Collaborative Planning to Improve Higher Education: System-Wide and Campus Initiatives" (Paul Spear); (16) "Generating a Positive Student Experience in Distance Learning Education" (Costas S. Spirou); (17) "Conceiving the Commons: An Interdisciplinary Approach to Environmental Literacy" (Linda Wallace, et al.); (18) "Active Learning Through Live Television: Reflections on Practice" (Michael F. Welsh). (All papers contain references.) (CH)

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The Center

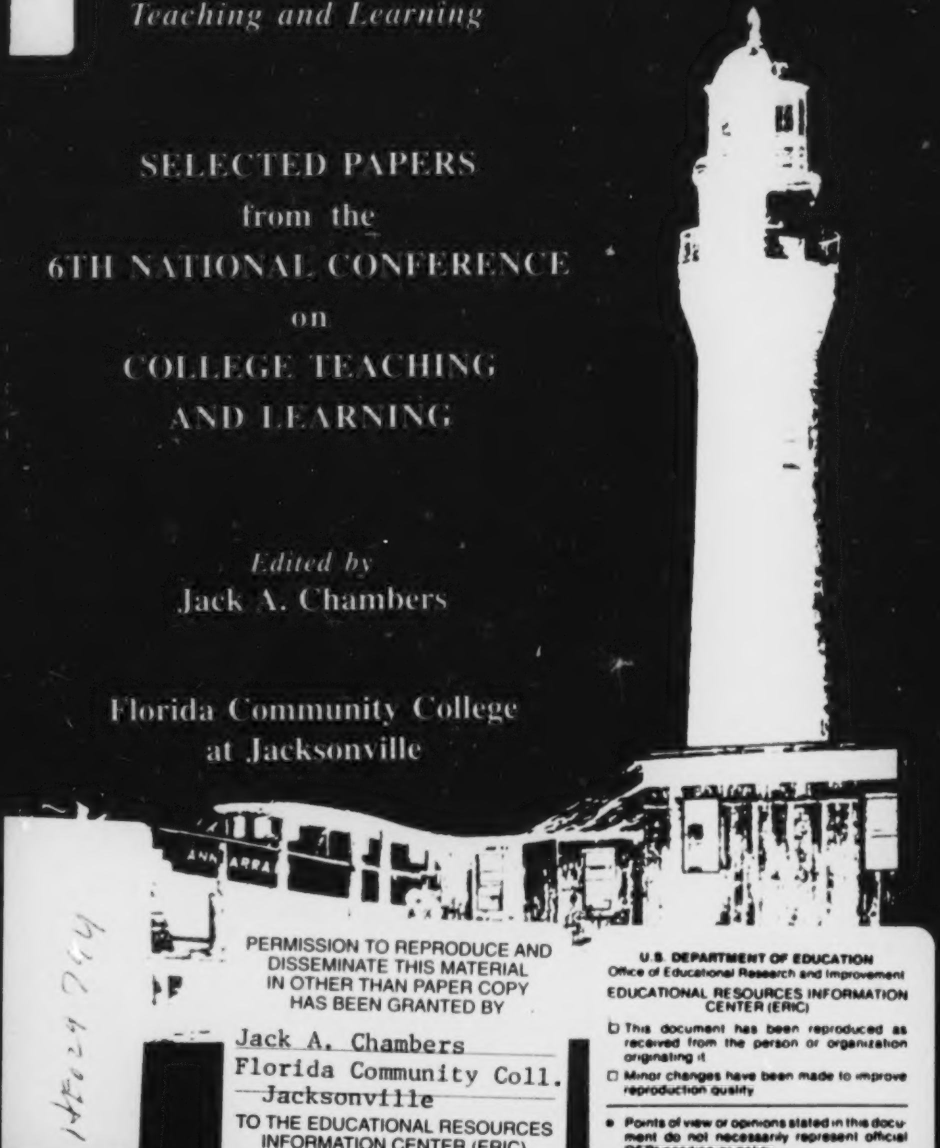
for the Advancement of

Teaching and Learning

SELECTED PAPERS
from the
6TH NATIONAL CONFERENCE
on
COLLEGE TEACHING AND LEARNING

Edited by
Jack A. Chambers

Florida Community College
at Jacksonville



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THE SIXTH NATIONAL CONFERENCE

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FOREWORD

The Center for the Advancement of Teaching and Learning was developed in 1987 when Florida Community College at Jacksonville (FCCJ) accepted the challenge to use the classroom as a modern laboratory for conducting experiments to gauge the impact of teaching on student learning.

The Center, with the philosophy that classroom teachers are the key to improving student learning, is composed of faculty members under the guidance of a steering committee, which consists of faculty from each of Florida Community College's five campuses. Part of the Center's success can be attributed to the numerous opportunities given to faculty to test their teaching ideas and put research results into practice.

The Center sponsors programs supporting faculty research mini-grants, classroom research, cooperative learning, faculty workshops, and adjunct faculty development.

In recent years the Center was awarded a Fund for the Improvement of Postsecondary Education (FIPSE) grant for "Cooperative Learning: A Catalyst for Change in the Classroom," which is providing intensive training and practice in cooperative learning strategies. This year, the Center received the Theodore M. Hesburgh Certificate of Excellence for their faculty development programs.

In an effort to stimulate creative discussion and promote experimentation to improve the teaching/learning process, the Center annually sponsors a national conference which features recognized educational leaders in diverse areas of teaching, learning, and technology. This publication, "Selected Papers", resulted from faculty interest in preserving and communicating some of the outstanding contributions to the conference.

Foreword

Many people are responsible for the success of the Sixth National Conference on College Teaching and Learning that was held in Jacksonville, Florida, April 5-8, 1995, with the theme of Teaching, Learning, and Technology: Creating Innovative Learning Environments. Thanks to all participants: featured speakers and workshop leaders; presenters from universities, liberal arts and community colleges throughout the United states and abroad; and faithful attendees. A special thanks to the Steering Committee for The Center for the Advancement of Teaching and Learning, and to Bill Martin, Jack Chambers, John Mullins, B.J. Schukis, Debbie Cyphers, and Beverly Williamson.

This journal contains 18 articles from the Sixth National Conference on College Teaching and Learning which represent a cross-section of the excellent presentations that were given. Thirty-eight papers were submitted for consideration for publication in this year's journal. Those that were selected for inclusion were juried by FCCJ faculty members.

Selection criteria included:

* Quality of content.

* Focus of the paper (i.e., teaching, learning, technology)

Selected Conference Papers

- Discipline

- Appeal to an audience of professional, post-secondary educators

- Theoretical or practical application

Plan to join us at the Seventh National Conference on College Teaching and Learning, March 20-23, 1996, in Jacksonville.

Gail Fredrick
Professor of Office Systems Technology

John Mullins Professor of Biology	Arnold Wood Professor of English

AFRICAN AMERICAN STUDENTS' PERCEPTIONS OF COOPERATIVE LEARNING EXPERIENCES

Lillie Anderton-Lewis
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North Carolina A&T State University

INTRODUCTION

This paper provides a report of a preliminary study that assessed students' perceived values of cooperative learning experiences as they related to academic achievement and educational effectiveness. The study also addressed student attitudes towards cooperative learning experiences. African American students served as the population in the study.

Background of the Study

Research studies have shown that African American students tend to be more disposed toward academic cooperation than toward individualism (Jagers, 1992). Kagen, et. al. (1985), observed that in comparison to European Americans and Latino students, African American high school students tended to express the most cooperative attitudes and record the greatest academic gains when placed in cooperative learning contexts. Boykin, et. al. (1992), also indicated that African American college students positively endorsed an ethos that placed a premium on social bonds and responsibilities associated with more cooperative academic attitudes.

The teamwork concept in the education sector is explained through the cooperative learning methodology. The most recent focus on teamwork in career activity is built around the success of group dynamics and interpersonal relationships. Since teamwork has become a vital component of the achievement of tasks in many corporations, it is important for students to be able to demonstrate that they have these skills when they begin their careers. However, Hudson (1994) stated, "Students normally are not provided sufficient opportunity to experience teamwork [in the classroom setting]" (Hudson, 1994, p. 61).

DESCRIPTION OF THE STUDY

Eighty-one African American and three Caucasian undergraduate students participated in the study. All were enrolled in three sections of a Management Concepts course offered in the School of Business and Economics at North Carolina AT&T State University. All students participated in a number of group work activities in class. They also were required to complete a major group project.

During the final examination period at the end of the semester, students responded to a questionnaire that included 31 questions about their perceptions of cooperative learning. The questionnaire design included a perception scale in the Likert format, a demographic section, and an open question component. Faculty involved in research and in the teaching of statistics examined the questionnaire for clarity and modifications. The questionnaire was also pilot tested in a business class of 24 students.

FINDINGS

Educational Effectiveness

Responses to questions about African American students' perceived values of cooperative learning experiences are shown in Tables 1 and 2.

Table 1. Cooperative Learning and Workplace Competencies

		Agree	Neutral	Disagree
1.	Enhanced decision-making skills	53%	31%	16%
2.	Sharpened critical thinking and problem solving skills	61%	26%	13%
3.	Improved communication skills	64%	20%	16%
4.	Strengthened ability to make ethical choices	41%	34%	25%
5.	Encouraged and stimulated productivity and creativity	64%	18%	19%
6.	Sharpened skills required in the work place	81%	9%	10%
7.	Provided an awareness of real work expectations	60%	24%	16%

Table 2. Cooperative Learning and Interpersonal Relationships

		Agree	Neutral	Disagree
1.	Enhanced skills in managing conflicts	65%	20%	14%
2.	Assisted in the understanding of roles of each team member	83%	13%	5%
3.	Assisted in the understanding of how others think and feel	87%	11%	2%
4.	Enabled me to work more effectively with others	78%	19%	2%
5.	Allowed me to recognize that teams' work only if each member brings knowledge/skill to the activity	83%	13%	4%
6.	Provided opportunities to learn from and imitate the most skilled member of the team	59%	28%	13%
7.	Encouraged constructive criticism and support from members	74%	19%	7%
8.	Fostered a genuine concern for each other	62%	24%	14%
9.	Fostered a spirit of cooperation	76%	18%	1%

Examination of the tabular data indicates that a high percentage of African American students felt very positive about the outcomes of their experiences. In addition, the degree to which students achieve competencies, and whether the performance of a method matches its designated purposes, appear to dictate the effectiveness of a teaching/learning method.

Results indicate that the cooperative learning method enhanced students' interpersonal skills, and provided them with the ability to perform work roles related to teamwork standards required in the work place.

Academic Achievement

Table 3 provides data relating to cooperative learning effects on ability to predict academic achievement.

Table 3. Cooperative Learning and Predicting Academic Success

		Agree	Neutral	Disagree
1.	Helped me prodict my course grade more accurately	34%	24%	42%
2.	Allowed instructors to recognize the perfromance of individuals in a group	38%	27%	35%
3.	Allowed for easy attainment of course objectives	54%	24%	22%
4.	Usually result in better grades on group assignments than on individual tests	41%	14%	44%

Academic achievement relates to an expected and/or earned grade. Over half of the students (51%) indicated that they expected to receive an "A" on the group project; 31% a "B"; 12% a "C"; 4% a "D"; 1% a "F"; and 2% did not respond. However, expectations for the final course grade were between "B" (38%) and "C" (36%). Only 20% (17 students) expected to maintain a grade of "A".

Responses also indicated that although students agreed that course work objectives were easily attained, there were a higher percentage of students who felt that individual grades suffered.

Positive/Negative Factors

Questions that provided information concerning student attitudes towards their cooperative learning experiences are identified in Table 4.

Table 4. Student Attitudes Toward Cooperative Learning

		Agree	Neutral	Disagree
1.	Work better with a group than alone	46%	19%	34%
2.	Learn more through this teaching method	47%	24%	29%
3.	Takes too much time	55%	31%	15%
4.	Teachers should give more directions	74%	14%	1%
5.	Loafers/freeloaders should be identified early, dismissed or reported to the instructor	73%	14%	13%
6.	More involved in evaluating the results	81%	18%	1%

Results indicated that there were many more positive than negative factors. However, special attention should be given to questions numbered 4, 5, and 6 in Table 4. A high percentage--seventy-four (74%)--felt that teachers should explain more clearly how students are supposed to tackle the activities. Eighty-one percent (81%) felt that they should be more involved in evaluating the results of the activities, and seventy-three percent (73%) felt that loafers or freeloaders should be identified early and then dismissed or reported to the instructor.

CONCLUSIONS AND RECOMMENDATIONS

At the university level, both previous research and the current study indicate that African American students appear to maintain the perception that engaging in cooperative learning activities is a means to attaining course work objectives. This study also indicated that cooperative learning activities enhance team building and interpersonal skills. Therefore, relevant cooperative learning activities are recommended to be made a part of classroom activities, especially those in which African American students represent a large proportion. In addition, to positively impact academic achievement and educational effectiveness, a learning style assessment is recommended to be administered to students to help determine their most effective learning style.

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LEARNING TO LEARN IS A TEACHABLE SKILL

Joan B. Baker
Robert L. Lance
and Ronald L. Moss
Cuyahoga Community College

INTRODUCTION

The purpose of this paper is to present discussion arguing for a paradigm shift in education, changing the emphasis from teaching to learning. The current educational model is teacher-driven. Historically, it emerged from a low technology culture in which the teacher possessed the educational materials and the most efficient way to present them was to read or tell the student the content. As technology improved and educational materials were more readily available, the model remained static with the teacher continuing to deliver information. Some attempts were made to modify the delivery of information or to allow students to become co-participants in the learning process. However, it appears that the learning strategies were ahead of the technology of the time. The changes were short-lived with the system regressing to the teacher-driven-telling model.

Currently, with advances in a number of fields (Cade, 1979; Dearth, 1985; Hutchison, 1994), the possibility of shifting attention to the learning process has become more feasible. Advances in computer hardware and educational software, advances in understanding the function of the brain in learning (Restak, 1984), and advances in biofeedback technology in both equipment and learning strategies (Hutchison, 1994), provide the foundation for making the shift.

ADVANCES IN COMPUTER AND MIND TECHNOLOGIES

Advances in computer technology now offer traditional educators the opportunity to provide information to the work station with flexible scheduling. The work station, of course, may be in the home, the public library, school or work environments. The traditional model (fixed time and place) can remain the same. However, the flaws and limitations of this model will become increasingly apparent.

Paralleling the advances in computer technology is a growing body of mind technology (Cade, 1979; Hutchison, 1994; Restack, 1984). The continuing developments in biofeedback equipment and procedures for increasing self-awareness demonstrate the possibilities for improving attention span and concentration, memory, reading speed and comprehension, critical thinking and academic achievement.

A current promising area for exploration is in brain/mind technology. The development of low-cost neurometric equipment allows for application of exciting findings which have formerly been restricted to major research centers (Hutchison, 1994). Educators interested in application of this research are now able to conceptualize learning in brain-processing terms and will be able to develop and measure learning activities that enhance neural processing (Restak, 1988).

IMPROVING LEARNING TO LEARN SKILLS

The shift to the learning process, rather than focusing on information-giving, will lead to improving learning-to-learn skills. Historically, this has meant teaching content around taking notes, how to take tests, how to read your text, and how to study. However, "learning to learn" here means much more than how to study and take tests.

Learning-to-learn in the context of this paper includes how to improve attention span and concentration, motivation, and memory; how to reduce anger, anxiety, and procrastination; and how to increase self-esteem and creativity. Further, it covers how to improve body/mind integration and self-confidence, and how to accelerate personal growth and develop inner peace. The intent of proposing a paradigm shift does not negate the value of curriculum or teaching; it acknowledges and embraces the personal qualities that allow a student to be optimized as a learner and to be full-functioning as a human being.

Cuyahoga Community College has two courses embodying the above approach: General Studies 101, "Personal Development", and General Studies 120, "College Survival Strategies." Also, during this past year, test anxiety workshops and applications of bio-integrative learning have been conducted. Beginning fall term, 1995, the College intends to pair General Studies 101 and General Studies 120 with beginning mathematics and English courses, creating a learning community for a selected group of new students.

FINDINGS

The findings from research conducted with General Studies 101 students show improved self-confidence, goal-setting behavior, communication skills, and acceptance of self and others. From the case studies utilizing bio-integrative learning techniques, students have shown marked improvement in academic performance, planning and concern for consequences, as well as reduction of anxiety and depression. The findings from attempts to reduce test anxiety have shown that it can be reduced significantly, resulting in improved academic performance.

A possible strategy for evaluating the consequences of focusing on the learning process is to create an extramural demonstration unit outside the mainstream of regular course offerings. This would allow for the evaluation of techniques and processes for improving learning-to-learn skills in a small sample of students. Those techniques and processes that prove viable can be expanded to include a larger number. The model of a small demonstration unit can provide an empirical base for change that does not destabilize the on-going instructional process. Change from this approach can be controlled and managed.

SUMMARY AND CONCLUSIONS

In summary, the advances in the various technologies from diverse fields are providing a window of opportunity for a proposed paradigm shift from teaching to learning. This is not a simplistic idea. It has profound implications for re-shaping the educational enterprise. Focusing on the learning process will require rethinking of educational procedures that shape teaching and administrative roles, and the use of facilities and equipment. It will also significantly impact the student, requiring active, rather than passive learning. The time for this idea has come.

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THE FLORIDA HIGHER EDUCATION CONSORTIUM: A MATHEMATICS, SCIENCE, TECHNOLOGY COLLABORATION

Marianne Barnes
Madeline Fernald and Laura Langton
University of North Florida

INTRODUCTION

Interest in the reform of science and mathematics education is well documented. The American Association for the Advancement of Science (Rutherford and Ahlgren, 1990), Biological Science Curriculum study (1989), the National Council of Teachers of Mathematics (1989), and the National Science Teachers Association (1991), emphasize the processes of science and mathematics, the interactions of science, technology, and society, and broad, meaningful, conceptual themes. These groups and others suggest the incorporation of applications of new cognitive theory. Other priority areas are addressing the needs of under-represented minorities; providing leadership institutes for teachers; using authentic and varied modes of assessment; including the community; and using technical and other tools to pursue mathematics and science investigations. The proponents of systemic reforms also emphasize the significant impact of context on the reform process. The separation between knowing what (knowledge) and knowing how (practice) has resulted in a mismatch between school and work.

Where does higher education fit in this broad scheme of educational reform? Certainly the higher education community must participate as active partners at all educational levels, but higher education must also engage in its own reform (King, 1994).

In addition to appropriate course development, the "contexts" of the classroom and the laboratory need to be revisited. Current research on learning continues to uncover the catalysts for learning and intrinsic motivation which have largely been ignored (Csikszentmihalyi, 1990). Teaching strategies can reflect current knowledge of the learning process and include non-traditional course development and instructional delivery in multiple contexts and by means of effective instructional technology. Strategies influenced by diagnosis of individual learner needs can support conceptual schemes and connections which promote meaningful learning, particularly in the critical areas of science, mathematics, and technology.

HISTORY OF FLORIDA'S HIGHER EDUCATION CONSORTIUM IN MATHEMATICS AND SCIENCE

For years, faculty in Florida's institutions of higher education have formed informal and formal groups to identify problems and solutions in the realms of teaching and learning science, mathematics, and technology. The groups have had limited success, however, often failing to promote long range reform because of lack of resources and policy level commitments. When the Florida Department of Education was awarded a State Systemic Initiative by the National Science Foundation, efforts to include higher education institutions in science, mathematics, and technology reforms escalated, culminating in the birth of the Florida Higher Education Consortium in Mathematics and Science.

The Florida Higher Education Consortium is an independent group of higher education faculty in the sciences, mathematics, science education, mathematics education, engineering, and related fields. Also included are informal learning center and school district personnel. The goals of the consortium involve making significant improvements in post secondary programs and instruction in science, mathematics, and technology. These efforts include restructuring teacher preparation and teacher enhancement programs using the State Systemic Initiative goals, Blueprint 2000, and the Florida prekindergarten through grade 12 (Prek-12) Science and Mathematics Curriculum Frameworks.

The initial meeting of the Higher Education Consortium faculty was held in December 1993, at the University of Central Florida, with approximately 70 persons in attendance. The conference brought together faculty from both public and private Florida colleges, universities, and community colleges.

A second meeting was held in May 1994, with over 125 participants. Attempts were made to include representatives of all Florida colleges and universities. The increase in the number of participants reflected the growing awareness of a need for fundamental change in science and mathematics education. A special effort was made to create regional collaborative groups. The Consortium began to operate as a virtual center with six regional hubs.

The Consortium continues to evolve and expand into an entity which encourages dialogue. While new community college, college, and university members are actively recruited, the Consortium is facilitating meetings between higher education and elementary/secondary teachers and administrators at both the regional and statewide levels.

Sessions occurred in conjunction with the Florida Association of Science Teachers meeting in Sarasota in October 1994. A third meeting of the Consortium was held in November 1994, with approximately 150 participants. The fourth, planned for May 1995, will include a professional development day sponsored by the Space Grant Consortium. Sessions will focus on analyzing problems and model programs associated with lower division science and mathematics experiences.

STRUCTURE OF THE HIGHER EDUCATION CONSORTIUM

Each of the six regions in the state has a Consortium contact person who facilitates regional meetings. At the state level, a steering committee is currently chaired by the State Systemic Initiative co-principal investigator, who represents post secondary institutions. Collaboration and linkages are synergistically creating systemic change. Funding for statewide meetings is provided by the State Systemic Initiative, and regional work is supported by innovative regional collaborations supported by Eisenhower Act monies. A partnership with the southeast regional laboratory, SERVE, has been initiated recently, as well as links with several policy level entities. The Consortium, acting as a change agent, has the potential to effect positive systemic educational change in Florida.

MISSION, GOALS, ACTIVITIES, AND EXPECTED OUTCOMES

A mission statement and four goals were established at the initial meeting of the Higher Education Consortium in 1993. These have been refined and expanded, with corresponding activities and expected outcomes for 1995. The steering committee approved the 1995 strategic plan at its February 1995 meeting.

***Mission statement*. The Higher Education Consortium will serve to facilitate communication among educational institutions as a basis for enhancing mathematics and science teaching and learning.**

Goals and Activities

***Goal 1.* Continue to establish the Consortium as a viable, virtual center that works to enhance mathematics and science education.**

A representative steering committee has operated since fall 1993, to guide Consortium activities. The composition reflects mathematics and science at the university, college, and community college levels, in addition to Florida Department of Education State Systemic Initiative, Eisenhower Act, and Florida Science Framework Project personnel. Consortium membership agreed to operationally define its structure as six regional hubs corresponding to the six Florida Department of Education regions. Each hub has a contact person.

Activities. Activities include the following:

1. Redefine the membership of the steering committee to reflect regional nature of the Consortium, and to include key Department of Education program personnel.

2. Refine communications among institutions and between the Consortium and local, state, and national policy makers; explore ways to strengthen collaborative relationships which support the comprehensive goals of systemic reform.

3. Continue biannual large group Consortium meetings to encourage sharing among members and regions, and to include school district and local, state, and national policy personnel.

4. Facilitate professional development opportunities for Consortium members, especially those which focus on reconceptualizing teaching and learning at the post-secondary level.

5. Work toward more equitable member representation in the Consortium, access to Consortium network, and contacts with the larger community.

6. Support development of applications for funded projects and implementation of initiatives which support the goals of systemic change.

Sample Outcomes. The Consortium electronic communications system will be refined; Consortium database, with member institutional mailing, fax, and e- mail information, will be shared among members; and a Consortium column will appear in each issue of the State Systemic Initiative "Discover News". Staff of the State Systemic Initiative will work with Consortium contacts to facilitate sharing of relevant reform documents and policy information provided through the National Science Foundation, Florida Department of Education, and others. Membership of the Consortium will include more community college personnel and move toward more equitable minority and gender representation. Representatives from museums and informal learning centers will be recruited and contacts with the business and political entities will be fostered.

***Goal 2*. Enhance the utilization of educational programs and resources.**

Activities. Activities include the following:

1. Identify programs and models that reflect Consortium and State Systemic Initiative goals.

2. Work with other Consortium members, State Systemic Initiative staff, school districts, and informal learning centers to share resources and educational programs of merit.

Sample Outcomes. The Consortium will cooperate with the Florida Post secondary Planning Commission to identify and publish model science and mathematics programs. The Consortium steering committee will coordinate plans with State Systemic Initiative staff to begin establishment of a central clearinghouse of models, materials, and innovative approaches in science and mathematics teaching and learning.

Goal 3. **Reconceptualize and restructure teacher education by developing models that meet the unique needs of educational communities.**

Activities. Activities include the following:

1. Study and discuss state models such as the Mathematics and Science prek-12 Curriculum Frameworks, the Science Teacher Development Framework, and the Educational Standards Commission Educator Accomplished Practices. Study and discuss national-level science and mathematics standards documents, and other relevant reform documents, including innovative teacher preparation and enhancement models. Discussions will focus on deep analysis of pedagogical and content issues, including science and mathematics courses/experiences and field experiences.

2. Develop new funding proposals and submit to appropriate foundations and agencies; analyze critiques of any past, unfunded projects and formulate plans for resubmission.

3. Develop and implement teacher as researcher models to establish a common ground between higher education faculty and elementary and secondary teachers as basis of successful collaboration.

4. Sensitize the higher education community to the critical need to address diversity and equity in teacher education models, including recruitment and retention issues.

5. Take an active role in the establishment of teacher education policy, i.e. certification, FTE requirements, accreditation, etc.

Sample Outcomes. Consortium members will compare current practice in teacher preparation and enhancement with recommended practice and begin the development of new models which are strengthened by the collaborative, collegial nature of the regional and statewide Consortium structure.

Within regions, Consortium members will work closely with State Systemic Initiative regional coordinators and district representatives to study, design, and begin implementation of action research studies using graduate degree programs and district professional development plans as delivery systems.

Consortium steering committee will coordinate planning with policy makers at Florida Department of Education, Florida Board of Regents, and boards of community colleges and private institutions within the state. Continuing contacts will be made with the state Post secondary Planning Commission and the Florida legislature.

***Goal 4.* Evaluate the systemic impact of the Consortium on the enhancement of mathematics and science teaching and learning at state, regional, and local levels.**

Activities. Activities will include the following:

1. Develop and implement an ongoing mechanism to evaluate Consortium activities.

2. Provide interactive forums to discuss Consortium research and evaluation plans, and results.

Sample Outcomes. Consortium Steering Committee and other members will work with State Systemic Initiative evaluation staff to design and implement a comprehensive evaluation plan which evolves from analysis of the past year's indicators of progress.

Consortium regional and state meetings will include discussion and planning of research/evaluation agendas matched to their goals.

SUMMARY

In summary, learning is enhanced when it occurs in a community of learners. Successful program planning and evaluation must be collaborative. Systems thinking should underlie learning and decision-making in higher education, as well as in the prek-12 communities.

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DIRECTIONS
IN THE
CORE CURRICULUM
FOR
COMPUTER SCIENCE
MAJORS

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INTRODUCTION

On Tuesday, February 21, 1995, an article appeared in *The Wall Street Journal*. The opening sentence set the tone for the remainder of the article. It stated: "There are several schools of thought about how to produce more top US computer-code writers" (Zachary, 1995, p. B1). This quote is very telling in that it points out that not everyone believes computer science educators have determined what to teach students, or even how to teach it. Commercial software companies argue that American universities should give students less theory and more practice. Educators counter with--employers encourage students to get very narrow, very deep experience that meets their company's current needs, but in the long run, breadth is better. Computer science educators generally agree that the needs of the corporations that hire their graduates should be taken into consideration when designing curriculum, but that skills specific to a particular job or corporation should not be the single driving force behind the educational process.

The arguments between education and industry cited above are not unique to computer science, but in some sense they may be more acute with computer science than with other disciplines. What is it about computer science that has produced, as described by some, an unbridgeable gap between industry and universities? The purpose of this article is not to directly address the gap, but to discuss more fundamental issues--ones that perhaps serve as the root of the problem discussed in *The Wall Street Journal*. Namely, "What is the current state of computer science education?"; "What has brought it to its current position?"; and, "What direction is it heading in?".

CURRICULUM MODELS AND ACCREDITATION

AN HISTORIC OVERVIEW

Computer science education is in its infancy compared with other academic disciplines. In addition, the knowledge base and the technologies surrounding it continually change at an astronomical rate. In some sense it is amazing that computer science education has progressed as well as it has considering the rapid changes with which it has had to deal.

Added to the equation is the complicating factor that as late as the mid 1970s no well accepted curriculum standards existed. In 1979 (Association for Computing Machinery), and again in 1991 (Association for Computing Machinery), the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers produced undergraduate curriculum guidelines that served as models for curricula developed by most colleges and universities that offered undergraduate programs in computer science. However, there were generally large variations in how these standards were followed from school to school.

There were several reasons for variations in adoption of standards. First, up to the mid 1980s there was no incentive to follow the standards, since no form of academic program accreditation existed in computer science. Second, many colleges had difficulty adopting the standards because of a shortage of Ph.D. computer scientists in faculty positions at the time. nly since 1986 has the Computer Science Accreditation Commission, which is the accreditation agency established by the Computer Sciences Accreditation Board, begun to accredit undergraduate computing programs. As of December 1994, there were 124 accredited computer science programs in the US (Computer Sciences Accreditation Board, 1994).

As the number of accredited programs grows, the body of knowledge taught at colleges and universities will likely become more standardized through Accreditation Board oversight and control. This should also result in more control over curriculum variation in terms of the depth and breadth of topics covered. A question that remains to be answered in an agreed upon way, however, is: "What is the best way to teach students computer science?" Not surprisingly, the introduction of new technologies has to date made the suggested answers large in number.

THE IMPACT OF TECHNOLOGY AND THE ROLE OF MATHEMATICS

Within the computing profession there is an on-going debate about "What is computer science?" Perspectives on the answer come from a wide spectrum, ranging from the mathematical abstractionists to the pragmatic programmers. Most computer science educators subscribe to the philosophy that one cannot do computer science well without understanding programming.

Wolz and Conjura (1994a; 1994b) support the belief of many other computer scientists that one cannot understand the underpinnings of computer science without a strong background in mathematics. Central to this premise is the idea that at the highest level of learning, students must be exposed to the theory of the field, both within the scientific discipline and from a mathematical perspective. And, at the lower level, students must gain mastery of implementation skills by applying mathematics and scientific reasoning to problem solving.

At some point implementation takes the form of programming. Here is where technology enters the arena. Prior to the introduction of the personal computer (PC) in the early 1980s, the bulk of programming was generally done on either mainframes or minicomputers. Programs were written predominately in *imperative* computer languages such as FORTRAN, PL/I, and C (programs written in imperative languages consist of instructions--imperatives--on how to carry out procedures --algorithms--in a step-wise fashion). Excluding differences in operating system environments and subtle differences in the syntax of various computer languages, the pre-personal computer era had relatively consistent programming tools to be used in support of computer science instruction.

With the advent of the PC, inexpensive compilers for languages like Pascal became available. PCs offered an inexpensive and convenient computing environment and structured languages like Pascal offered improvements to the older family of imperative languages. These two new technologies resulted in many computer science students using similar programming tools in support of learning, which contributed to the standardization of the introductory core curriculum. A review of textbooks used throughout the 1980s offers strong evidence that students were being taught computer science through the use of standard, classical problems with a focus on the implementation of the problem/solution using highly structured imperative languages. In some sense, instruction during the 1980s was in a very steady state, perhaps more stable than will be seen again.

During the late 1980s and early 1990s isolated pockets of resistance to the above described instructional model began to appear. Experimentation with the use of different computer language paradigms began. For the uninitiated, Budd (1995) provides a comprehensive discussion of the various paradigms that currently exist.

Experiments with new paradigms include the work of Skrubles and White (1991) on object oriented programming (objects are manipulated to obtain results), with languages such as Smalltalk, and the work of Reid (1993) with hybrid languages like C++, which offers both imperative and object-oriented features. Also included would be the work of Conjura, Neff and Wolz (Neff, 1993; Wolz & Conjura, 1994a; Wolz & Conjura, 1994b) on functional programming (programs which look and act much like mathematical functions), with languages like Scheme and Mathematica, and logic programming (languages which specify the problem, rather than tell how the computer is to solve the problem), with languages like Prolog.

In most cases the curriculum experimenters argue that nonimperative languages provide features that enhance a student's ability to internalize high-level concepts, while at the same time they insulate students from the minutia associated with imperative languages. One camp, the advocates of object oriented programming, have strong support from industry. Software system features such as graphical user interfaces (GUI) are based on this approach.

Most computer science educators agree on the necessity of students to be graduated with a mastery of object oriented programming skills. Therefore, the current trend is in this direction, regardless of which language paradigm students see in the early part of the curriculum. To date, the hybrid language C++ appears to be the choice of the masses, over the objections of a minority who argue in favor of *pure* object-oriented languages like Smalltalk.

Since computer science is built on a strong foundation of programming and mathematical skills, it is important not only to look at the impact that PCs and language paradigms have on learning computer science, but also to examine how mathematics training enters into the educational equation. The Computer Sciences Accreditation Board (1994) recommends that all computer science majors take a minimum of one year of calculus and courses in discrete mathematics and probability and statistics. What the accreditation guidelines do not address is: "What articulation, if any, should exist between the computer science and mathematics courses that computer science majors take?"

The studies of Conjura and Wolz (1994b) indicate that it is not uncommon for students to be exposed to theoretical concepts in mathematics and computer science in such a way that they are walled off as abstractions unrelated to applications. It is also common that large time gaps exist between when students are exposed to mathematical concepts and when these concepts are needed as background in a computer science course. Another common practice is that courses like discrete mathematics are taught with minimal focus on the subject's strong ties to computer science.

Neff and others (Neff, 1993; Wolz and Conjura, 1994a; Wolz & Conjura, 1994b) have made recent attempts to integrate mathematics and programming into the computer science curriculum with promising results. These studies provide indications that such articulation contributes to a student's ability to obtain an early grasp of abstract computing concepts such as recursion and algorithm complexity. However, unlike the situation where object oriented programming appears to be a necessary and agreed upon programming methodology, a widely applicable curriculum model that closely articulates mathematical and computing concepts is less likely to emerge as a standard for the masses. A basic issue involves course control by different academic departments. Such issues are not easily resolved.

CONCLUSIONS

The buzz words for the mid 1990s in computer science education appear to be *object oriented programming using C++*. In fact, some permutation of a subset of these words appears in a major percentage of introductory computer science textbook titles. Large numbers of computer science students across the country are learning object oriented programming through the hybrid language C++. The computer science purists are unhappy, but employers are applauding. For better or worse, this direction is unlikely to change soon.

What then is the trend with respect to mathematics? In many cases computer science students view mathematics as a requirement of the major and an intellectual hurdle of graduation. However, on one edge of the educational spectrum, a few computer science curricula attempt to optimize the exposure that students have to mathematics by articulating it along with programming as a foundation to the study of computer science. Whether or not such a model will become widely adopted remains to be seen.

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TEACHER IMMEDIACY AND DISTANCE LEARNING: THE MULTICULTURAL DIMENSION

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INTRODUCTION

The importance of teacher immediacy behavior as a positive influence upon teacher-student interaction has been accepted since Anderson first connected the Mehrabian immediacy construct to the instructional context (Anderson, 1979). Similarly, distance learning has swiftly evolved from telephone conferencing to the present multi-site, multi-media networks. However, emerging from the research at an equal pace is the certainty that low levels of immediacy in the distance learning classrooms are the most serious obstacles to successful communication between teacher and learner.

For learners to feel rapport with the providing institution and with the instructor in a distance learning context, Holmberg (1985) found that they needed to be motivated, to experience learning pleasure, and to participate in discussions and decisions. Russell (1991) called for the use of facilitators at the distant sites to increase student involvement. Langford and Seaborne (1989) recommended one-on-one teleconferencing to personalize instruction. Barker and Patrick (1989) noted that teachers who forced interactions by using students' first names and heightened collegiality with self-disclosure, motivated students and measured stronger outcomes than did those teachers who packaged course content for the video camera.

While most instructional communication research focuses on "typical" American classrooms, studies which examine ethnic diversity within an increasingly technological America reflect the educational reality of the twenty-first century. Domestic multiculturalism and increasing proportions of international students have transformed classroom demographics, bringing greater challenge to the instructor's role as learning facilitator.

Today, successful nonverbal immediacy behaviors must include a repertoire of positive reinforcers which act in different ways to motivate and engage individuals in multicultural classrooms. When these classrooms are extended electronically through interactive distance learning technologies to two--or twenty--studio sites, a new element, "teacher as television persona", complicates the communication mix.

Research on teacher immediacy impact on cognitive learning from the intercultural perspective must be extended to the multi-link "glass" classroom. If the outreach potential of distance education is to be fully realized, new strategies must be developed to enhance teacher responsiveness among multi-cultural student groups which may be thousands of miles apart.

IMMEDIACY, DIVERSITY AND DISTANCE

The multicultural dimension within immediacy and distance learning research deserves more than the scant attention recent studies have paid. Nowhere is cultural diversity more apparent than in the classrooms of colleges and universities today (Evangelauf, 1990). Unanswered questions arise regarding actions known to produce certain perceptions and specific cognitive and affective responses in previous learning situations. Will these actions produce the same responses in students with different ethnic backgrounds?

Compounding the problem, evidence indicates that teachers have only begun to realize that they need to modify some of their behaviors to successfully communicate in diversity situations (Raybourn, 1994) difficulties multiply in the distance learning environment. Barrera (1993), stated that in spite of the rapid expansion of distance instruction systems, "few applications have been designed focusing on specific ethnic or cultural goals" (Barrera, 1993, p. 11). Furthermore, within the profession (i.e., faculty who use distance learning), a scarcity of minority teachers exists (Choy, et.al., 1993).

The present day minimal focus on diversity issues is likely to widen the gap between information "rich" students and those who are "poor." As an example, in 1988, an ambitious, government sponsored program, Star Schools, began to bring the information age to poor, minority, female, rural, and disabled Americans (Irving, 1993). Over one hundred million dollars was spent in beaming, via telecommunications, distance education to 200,000 students from 30,000 teachers. Focused on underserved metropolitan and isolated rural communities, courses in math, science, and foreign languages packaged the curricula satisfactorily. But, as Berra (1993) pointed out, the Stars Schools Program almost ignored cultural diversity; it was concluded that this need must be met.

CULTURE-SPECIFIC BEHAVIORS

What have the cultural experts observed as the principal differences in learning behaviors among ethnically diverse students?

They respond in predictably different ways (positively or negatively) to nonverbal immediacy, verbal immediacy, and message clarity. Nonverbal immediacy includes animated gestures, increased physical proximity, direct body orientation, frequent smiling, personalized eye contact, and voice tone variations. Verbal immediacy covers self disclosure, and student first name recognition. Finally, message clarity includes implicit and explicit messages, and use of idiomatic expressions (Powell & Harville, 1990; McLemore & Cunningham, 1993; and Raybourn, 1994). Clearly, teachers must somehow adapt various styles of responsiveness that work well in multicultural classes to the highly restrictive telecommunications system.

How can the above be achieved? One study (Hackman and Walker, 1994) compared students who received the same course information face-to-face with those who received it at a distance. Student perceptions of the four trained instructors' use of verbal and nonverbal immediacy behaviors were measured. Only slight differences arose on five of twenty verbal immediacy areas: use of students' first names; conversations before and after class; discussions with students about assignments; use of humor; and recognition of students by name. All of these, of course, would be more difficult from a distance than in classroom proximity.

Only the use of humor was appreciated more strongly by the distance group than by those in the face-to-face group. No mention was made of the ethnic mix in this study nor of the students' technological competencies. But, when instructors engaged in "immediate and socially present behaviors, perceptions of learning, satisfaction, and information transfer...were not different in the two modalities" (Hackman and Walker, 1994, p. 10).

STRATEGIES FOR THE MEDIUM

Aware that the technologies of distance learning limit the availability of nonverbal information, and that "distance" is psychological as well as physical in any instructional environment, the successful telecommunication teacher must apply strategies for creating a "contextual immediacy" (Burge, 1991). In order for this context to incorporate communication behaviors that convey approachability and interpersonal warmth and closeness-- across and within cultural groupings--diversity as well as technological training is essential (Murphy & Farr, 1993). The teacher/system manager should address two levels of immediacy behaviors in a culturally mixed distant class-- universal cues, and culturally normative cues.

Teachers who are nonverbally expressive, using purposeful, emblematic gestures, encouraging head nods, and high eye contact (simulated, of course, via camera attention), improve student attitudes toward the learning experience (Sanders & Wiseman, 1990). Other cross-cultural immediacy behaviors that enhance learning include increased smiling (emphasized with well managed video close-ups), relaxed body positioning, and apparent ease of equipment operation (Richmond, Gorham, & McCroskey, 1987).

Universal, verbal immediacy expressions which were found to adapt well to two-way, real-time video link-ups in multicultural ESL classes (Raybourn, 1994), were first name recognition during discussions, discreet use of subject specific humor, instances of self-disclosure, praising students, and using vocal variety in a slightly dramatic manner. Contact cultures (Latin American, Middle Eastern, Southeastern European) respond positively to closer proximity instruction in the conventional classroom environment; distance cultures (North American, Asian, Northern European) do not (Dodd, 1995).

Distance instructors are limited in the degree to which they can modify their own nonverbal behaviors when addressing diverse groups. However, each can coach on-site facilitators (Cunningham & McLemore, 1994), regarding reinforcing and individualized behaviors like touching or translating idioms (Hecht, Anderson, & Ribeau, 1989). Verbal references to appearance details which identify *and* complement ethnicity, or explain course content with culture-specific vocabularies, can produce a para-social affinity between student and instructor (Walker and Hackman, 1991).

CONCLUSIONS

Overall, the results of instructional immediacy research in distance learning suggest that such behaviors can be communicated across interactive distance learning systems, and they do enhance learning. However, specific strategies, including those to meet the needs of multicultural students, require identification and practice with the actual technologies.

That not all universities follow this practice has been observed by Jacobson (1995), in analyzing training offered by a major private university described as "hands-on instruction in interactive, simultaneous communication." Although it appeared to be teacher-taught distance learning, the training turned out to be menu-driven, computerized instruction.

Specific training programs are needed which provide opportunities for faculty to develop and practice strategies of instructional immediacy behavior in distance learning situations involving multicultural students. Teachers will require training in multicultural perceptions to heighten spontaneity, and thereby enhance learning.

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LIBERAL EDUCATION

IN TECHNOLOGY

COURSES

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INTRODUCTION

In many institutions, technology and computing courses have remained outside the core of courses that are offered as general education or liberal education courses available for all students. As computers and technology continue to increase in importance in the fabric of life in this country, courses in technology and computing can and should be included among those providing a general education for students. This article will present two technology courses that are quite different from the traditional skill-based technology courses. Instead of focusing strictly on computer skills (such as programming, spreadsheets, database management), the courses have been re-oriented to focus on developing general liberal education skills such as critical thinking, reflecting and acting, engaging with other learners, and understanding contexts--within the framework of substantial computer-related topics.

LIBERAL EDUCATION

An appreciation of the value of a liberal approach to higher education has arisen over the past century. Many authors and educational theorists have defined liberal education and a set of criteria for liberal curricula (Boyer, 1990; Boyer and Levine, 1981; Rosovsky, 1990). Although computer science is often considered a discipline that emphasizes technical and vocational aspects of education, several scholars have identified the strong relationship between computer science and a liberal education (Beck, Cassel & Austing, 1989; Decker & Hirshfield, 1990; Gries, 1991).

Miami University is well known for its liberal arts undergraduate education (Moll, 1985). In the late 1980s the university revised its undergraduate liberal arts curriculum (Miami University, 1989) to include a set of foundation courses. These courses were derived from five separate areas: English composition (6 hours); fine arts and humanities (9 hours); social science and world cultures (9 hours); natural sciences (9 hours); and mathematics, formal reasoning and technology (3 hours).

Other portions of the plan included a thematic sequence of courses for depth in one area, and a capstone experience. In the words of the plan, "Liberal education involves thinking critically, understanding contexts, engaging with other learners, reflecting and acting, habits that extend liberal learning through a lifetime to benefit both individual and society" (Miami University, 1989, p. 10). Each foundation course in the Miami Plan must incorporate the principles of thinking critically, understanding contexts, engaging with other learners, and reflecting and acting.

THE COURSES

Computers, Computer Science & Society

Historical Perspective. SAN 151, "Computers, Computer Science and Society" is a foundation course that satisfies the technology requirement of the Miami Plan. This course had previously existed as a different course named "Introduction to Computers." Over the years, as technology and computers became more pervasive, the course lost a clear focus and tended to include topics that were actually covered in other introductory courses. The call for courses for the Miami Plan in the technology category provided an opportunity to redefine the course, in focus and in content.

Description of Current Course. The primary objective of the current course is to develop a perspective on the potential and limitations of computer science and computing technology. Topics include the impact of computing on societies, models of computation, major paradigms for use of a computer, and a variety of legal and ethical issues. The course exposes students to programming languages, electronic communications, and various other tools such as word processors and spreadsheets.

The course is a blend of philosophic thought and pragmatic illustration. Consistent with this dichotomy, there are two separate types of class meetings -- traditional lecture/discussion meeting for the more philosophic and conceptual topics, and a laboratory environment for concept illustration. Lectures are used to introduce some of the more technical components of the course such as computer programming and systems design. Discussion is the primary mode on topics such as impact on computing on society, and ethical and legal issues of computing.

Many of the sessions require a student to take a stand and critically argue an issue. For instance, students argue whether the use of tools such as word processors and spreadsheets diminishes basic writing and mathematical skills. Laboratories are not "cookbook" type directions for students to follow. Instead, student teams are given a task to accomplish and the supporting documentation. They then work in pairs to determine how to accomplish the goal--a process that is sometimes quite frustrating.

Typically, the class meets once a week in the laboratory and once in a traditional classroom. The specific course requirements include examinations, laboratory reports and lab quizzes, homework (typically 2 page essays), and a term paper or book report. More detail on the laboratory component of this course can be found in Kiper and Bishop-Clark (1994).

Introduction to Computer Systems

Historical Perspective. SAN 163, "Introduction to Computer Systems" also satisfies the technology component of the Miami Plan. Like SAN 151, this course had existed for many years. However, this course did not lack a focus or clearly defined topics--it was an introduction to programming for students who had little or no previous programming experience. The course was primarily lecture that attempted to present as much information and experience as possible in writing and running programs. Students did all work individually on computers outside of class.

Description of Current Course. The current, liberal education version of this course has retained its focus on computer programming, but has adjusted its goals so that any student can take the course and learn the basics of computers. The course now includes a weekly lab activity that provides students hands-on experience with the instructor present--and often provides opportunities for students to work together to develop solutions. These lab experiences usually contain a guided portion and a creative portion, focused on a programming topic (such as loops, arrays, etc.).

There is a common thread throughout the course of helping the students understand the various contexts of computer programming. This is achieved through discussions and assignments focused on those affected by the computer program--the creator, the reader of the program, the user, and the society at large.

Course requirements are quite rigorous. They include out-of-class individual and group programming assignments, written comments about the structure and usefulness of the lab activities, writing assignments (usually papers, or responses to articles), tests, quizzes, and a comprehensive final. The traditional topics of modular programming, selection structures, repetition structures, arrays, strings, and sequential file processing are still presented in this course. The challenge to the instructor is to continuously connect the topics and assignments to liberal education principles and societal implications.

ASSESSMENT OF COURSES

An important aspect of all Miami Plan courses is the inclusion of an assessment plan for each course. The two courses discussed in this paper include informal assessment activities throughout the course, and a formal, standard assessment at the end of the course. This final assessment involves a comprehensive questionnaire* focused on the liberal education aspects of the course as well as the specific course content and goals.

At the end of each semester, the responses to the assessment document are collected, tabulated, and returned to each instructor. The instructor uses this information to target those items which need improvement for the next offering of the course. Assessment reports are also forwarded to the university Liberal Education director.

CONCLUSIONS

Both of the above courses differ from "typical computing courses" in that the focus is not solely on technology, but on the interaction of technology with liberal education themes. In each course, students are reminded regularly that this course is about understanding contexts and critical thinking--not just about computers. Far more important than knowledge of a particular software package or programming topic, is the liberal education skills that are learned. Software packages and technical jargon are easily forgotten and quickly outdated, but skills such as critical thinking, working with others, and reflecting should last a lifetime.

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LEARNING AND MOTIVATION THEORY APPLIED TO INSTRUCTION

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INTRODUCTION

This paper provides a brief overview of the prominent views of learning and motivation that are now influencing instruction in our public and private schools, colleges, and universities. The paper will briefly examine behaviorism, social learning theory, information processing, and constructivism as the dominant views of learning. In addition, expectancy x value theory as it applies to motivation will be examined. The paper will also briefly describe research that has examined assessment practices and the impact that these practices have on student learning.

BEHAVIORISM: A PHILOSOPHY OF LEARNING

Behaviorism describes learning as a change in observable behavior that results from experience (Mazur, 1994). B.F. Skinner (1904-1990), whom heads of departments of psychology late in the 1960s identified as the most influential psychologist of the 20th century

(Myers, 1970), is the most prominent figure in the field. Skinner argued that behaviorism is more a philosophy than a theory with its focus on observable behaviors. In its pure form, behaviorism attempts to meet the criteria for being a true "science."

Behaviorism has important implications for instruction. It teaches that learning is the result of reinforcement and punishment. Applied to instruction, it suggests that information to be learned must be presented in such a way that the desired performances can be reinforced. This means that information should be organized into small, isolated, and decontextualized pieces, which gradually accumulate to higher-order abilities. Learning in this context is hierarchical, and prerequisite skills and abilities must be mastered before higher levels of learning can be attempted.

A great deal of curriculum is based on behaviorist principles. Looking at grammar rules, for example, it may be noted that they are usually described and then illustrated in isolated sentences. Later the learner is to demonstrate correct usage of the rule on other sentences. The tacit assumption is that these performances will eventually result in skilled writing.

Behaviorists have also attempted to explain motivation. A behaviorist explanation for motivation focuses on the use of reinforcers to motivate behavior.

SOCIAL LEARNING THEORY

Social learning theory is based substantively on work by Bandura (1986; 1989). It is rooted in behaviorism, but goes well beyond it.

Modeling is probably the most prominent concept to exist in social learning theory. Modeling is used to explain how individuals acquire new behaviors, facilitate existing behaviors, change inhibitions, and arouse emotions. It can either be direct or symbolic. Models that are perceived as competent and similar to observers are the most effective. High status models tend to be regarded as having competence outside their areas of expertise.

A concept called *cognitive modeling* has become influential in instruction. Cognitive modeling provides access to the thinking of experts, allowing the teacher to share the thought processes involved in analyzing and solving problems.

Social learning theorists view reinforcement and punishment differently than do behaviorists. For behaviorists, they're a direct cause of learning. For social learning theorists, they create expectations, which in turn impact motivation.

Social learning approaches to motivation can also be characterized as expectancy x value theories (Feather, 1982). This is because they suggest that learners will be motivated to work on a task to the extent that: 1) they expect to succeed on the task; and 2) they value achievement on the task. If both are present, learners may develop a sense of *self-efficacy* or a perception that they can succeed on challenging academic tasks. Self-efficacy is impacted by past experience, the experience of others, persuasion, and modeling.

INFORMATION PROCESSING

The beginnings of the "cognitive revolution" are often traced to a symposium held at the Massachusetts Institute of Technology in 1956 (Bruer, 1993). A number of research programs were merging and pointing to a paradigm shift, away from behaviorism and toward a "science of the mind." It was at this symposium that Noam Chomsky (1956) presented a convincing criticism of behaviorism as an explanation for language learning. At this same gathering, Newell and Simon (1956) first suggested the link between computer and human information processing, and Miller (1956) introduced the concept of "chunking" individual bits of information into more meaningful units.

Information Processing -- A Computer Model of Cognition

Information processing describes learning in terms of three information stores--sensory memory, working memory, and long-term memory. It deals with cognitive processes, such as attention, perception, rehearsal, encoding, and retrieval; and finally, metacognition, which is knowledge and control of cognitive processes.

Information processing suggests that learning begins when information is essentially "photographed" by sensory memory, moved as a result of attention and perception into working memory, and finally, stored in long-term memory as meaningful representations are formed. Working memory's most significant characteristic is its limited capacity (Bruer, 1993). As a result it is often called a "processing bottleneck" (Gagne, Yekovich, & Yekovich, 1993). Its capacity can effectively be increased, however, through the process of "chunking" and automaticity. Expert performance in any field is characterized by the ability to recognize patterns which allow large amounts of information to be "chunked," and a great deal of automatic processing.

CONSTRUCTIVISM

All cognitive theories are based on the assumption that learners are active in developing their own understanding of the topics they study. Some researchers, however, argue that theoretical approaches, such as information processing, don't emphasize the process of *knowledge construction* as much as they should (Derry, 1992). Most experts agree that Constructivism has the following five characteristics: 1) learners construct understanding; 2) new knowledge depends on prior understanding; 3) learning is the result of conceptual change; 4) understanding is socially constructed; and 5) meaningful learning occurs within authentic learning tasks.

LEARNING AND ASSESSMENT

"Here is something approaching a law of learning behavior for students: namely that the quickest way to change learning is to change the assessment system" (Elton & Laurillard, 1979, p. 100). This quote on teachers' classroom evaluation practices, underscores the powerful effect that teachers' quizzes, tests, and other assessments have on the learning behavior of students. For a review of instructor assessment practices and their impact on learning, see Crooks (1988).

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BRINGING THE NEW TECHNOLOGIES TO DISTANCE LEARNING: A BRITISH PERSPECTIVE

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INTRODUCTION

There are over 130 higher education institutions in the United Kingdom (UK) offering some form of distance teaching to students both in the UK and throughout Europe. The British Open University is the largest of these, and like most other institutions in the higher education sector, is currently faced with the challenge of the new technologies and the role they will play in education. This challenge applies equally to institutions presenting teaching materials at a distance or in the traditional way.

The Open University has always offered its students a rich mix of media, but has sometimes found it difficult to produce a coherent learning environment which sensibly integrates the different media types. The new technologies make it possible for the University to deliver its teaching materials within an integrated learning environment. As a distance teaching institution, the Open University can also benefit greatly from student access to a range of networked services which are offered through modern computer-based networking facilities. Equally, the rapid technological changes taking place are creating problems for students who in the main, are providing their own access to the technology. Problems also exist for academic staff who are expected to begin to exploit the new technologies in their teaching, while still maintaining an acceptable level of research.

The Open University is in the process of launching a major initiative to address these issues and move the institution towards the eventual integration of new systems and technologies into its teaching program. These initiatives are relevant to other distance institutions --and some parts, to the higher education community at large.

NATIONALLY SUPPORTED PROGRAMS

A number of key programs are in place in the United Kingdom to assist the higher education community in its efforts to bring the new technologies into the curriculum.

Computers in Teaching Initiative

The *Computers in Teaching Initiative* was established in 1985 with British government funding. The first phase supported 139 courseware development projects with at least one in each UK university, and in almost every discipline. In 1989, as a follow up to these projects, a number of discipline-based dissemination centers were established. Between them, the 20 centers cover more than 90 percent of all subjects taught in undergraduate courses. Each center combines a thorough understanding of the teaching needs of its discipline with expertise in computer-based teaching and learning techniques. The centers have played a useful role in identifying courseware and resourceware suitable for UK higher education. Funding for the centers is guaranteed until July 1999.

Teaching and Learning Technology Program

The first phase of the Teaching and Learning Technology Program was launched in 1992 by the British Universities Funding Council. The aim of the program was "to make teaching and learning more productive and efficient by harnessing modern technology." Universities were invited to bid for funding for projects which could extend up to three years. Projects could address problems of implementation within single institutions, with staff development being a major component, or be concerned with courseware development. The latter type of projects tended to involve academics from different institutions working as consortia. Out of around 160 submissions, 43 projects shared the funding of £7.5 million a year over three years.

The second phase of the program was launched in 1993 with the same aims as the first, with hopes to build on the work already being undertaken by the phase one projects. This phase attracted 367 bids and a further 33 projects shared a total funding of £3.75 million in 1993-94.

Joint Academic NETwork

The Joint Academic NETwork (JANET) was created in April 1984 by expanding and enhancing an existing wide-area network being used by researchers in the UK. It was required to maintain compatibility with the public X.25 network and access was restricted to the academic community. At its inception, the network provided access at 9.6 Kbit/s and served about 50 sites. It was gradually upgraded to its current level of 2 Mbit/s access, making it the highest performance X.25 network in the world. The user community has also been broadened and now takes in about 200 sites. A network IP Service was introduced in 1991, and was implemented so that both IP and X.25 services dynamically shared the JANET bandwidth.

In 1992, a new development phase began on SuperJANET, a high performance wide-area network based on fiber optics, that would provide a considerable enhancement to that offered by JANET. A 34 Mbit/s pilot data network and a 34 Mbit/s pilot ATM network have been implemented and made available to 60 sites. The development plan includes the provision of a 155 Mbit/s ATM/SDH network and further expansion of the network.

THE OPEN UNIVERSITY

The Open University is a world leader in distance education and has over 200,000 students taking courses each year. The University awarded BA/BS degrees to over 150,000 students between 1971 and 1993. Unlike many other distance education institutions, the University offers tutorial and counselling support to undergraduate students. In 1994, some 7,400 part-time staff were employed in this capacity throughout the UK.

The University has used a rich mix of media since its inception some 25 years ago, and computer-based technologies have come to play an increasingly important role in its teaching program (Butcher and Greenberg, 1992; Greenberg, 1995). Over 25 percent of undergraduate students require access to a personal computer, and over 60 percent use computers at the University's residential summer schools. By 1997, some 20,000 students will be equipped with a computer and a modem at home, and will be using electronic mail and computer-mediated conferencing as a normal part of their learning environment. They will also have access to other networked services such as remote information sources through the Internet.

It is hardly surprising that having made the commitment to acquire today's technology, students expect the University to fully exploit it to their academic advantage. While solutions have, or will be found for most technical problems, the University has to address the broader issues of how to stimulate and motivate academic staff, and how to fundamentally change its course production processes. Some of the key elements of a new multimillion pound initiative which will address these issues are described below.

Academic Staff Renewal

Two major studies have been carried out in the United Kingdom to look at the provision of computing facilities for teaching in universities, and the role of the new technologies in creating new learning environments (Inter-University Committee on Computing, 1991; and Committee of Scottish University Principals, 1992). The first of these studies recognized that there was little incentive for academic staff to become involved in the development of computer-based teaching material. Its subsequent recommendation was that "...Universities attach greater weight to the development and creative use of teaching software in determining the promotion prospects of lecturing staff." (Inter-University Committee on Computing, 1991, p. 25).

The second study pointed out that the introduction of innovative teaching methods required appropriate methods for the management of change. It also addressed the incentive issue by noting that "the introduction of programmes to expand innovation in teaching must be set within the context of staff training and staff development and must first address the questions of benefits for the individual" (Committee of Scottish University Principals, 1992, p. 33).

The Open University has observed that like many other universities in the United Kingdom, the current age profile of academic staff is skewed towards the older age groups. Since younger academic staff are increasingly proficient and interested in new technology, the University is organizing a "new blood" scheme. This will bring in a number of younger academic and support staff who combine high promise in their disciplines with expertise in the use of new technologies.

The University is also planning a major training program for existing staff, although such programs have not been very effective in the past. There does appear to be, however, a growing interest in the potential of multimedia within the institution. Bids were recently invited from all academic units as part of a staged funding scheme for multimedia projects, which is described below. A large number of bids were received from almost every academic unit. They requested funding which, in total, came to ten times the amount available. The "new blood" scheme and the growing awareness within the existing academic community should hasten the University's move into a period of academic renewal.

Innovations in Course Material

The Open University courses have always maintained the highest quality in printed texts. From its inception, courses have been enriched by the inclusion of non-print study materials such as home experiment kits (a comprehensive chemistry kit is sent to students in one course), audio cassettes, video cassettes, slides, and computer software. The University has now added CD-ROM to this impressive list and is increasingly holding all of its teaching materials in digital form. Integrated multimedia learning environments are an obvious delivery mechanism for this range of material, although today's display technology is still not good enough to replace the printed texts entirely.

The University has developed a plan to gradually introduce integrated multimedia learning environments into its courses. The first stage was to distribute £2,000 to 17 projects from eight academic areas. This so-called "seed" funding was intended to give academics the opportunity to undertake initial research and consider the issues associated with full multimedia developments. The second stage was to fund another six seed projects and fund nine other projects at more substantial levels. These are expected to deliver demonstrator products by the end of 1995.

A multimedia projects fund will continue to receive resources for a further three years. It is anticipated that the material developed will gradually be introduced formally into course material.

Access to Networked Services

By 1997, the University will have over 20,000 students studying at home with a computer-based communications facility. Access is being provided to an e-mail facility, computer-mediated conferencing software, and the Internet. Many courses are planning to use remote information sources in their teaching, and some courses are being taught entirely electronically. Students in some courses are submitting assignments electronically, and eventually the whole student administration system will be on-line. Given the number of students studying with the University, careful planning is going into the provision of the networking infrastructure required to support such a system.

A number of collaborative learning environments have already been created which contain multimedia elements. A number of courses have permitted students to collaborate electronically on their project work, while drawing on CD-ROM based resources and the usual on-line tools such as word processors and spreadsheet packages. As bandwidth increases, it is anticipated that a wider range of media will be provided over the network.

The University is involved with Carnegie Mellon University in the USA in the Informedia Project. This project is developing a digital media library and facilities for automatic searching of video material. It is hoped that this will lead eventually to the University's own online digital media library.

Addressing the Access Issue

In 1994 more than 60 percent of all Open University students had access to a computer suitable for use in connection with their studies, and some 20,000 students were registered in courses which required them to provide access to a personal computer. As new courses increasingly require access to higher specification equipment, some form of assisted access will be required by many students until personal computers with multimedia capabilities become common place in the home. The University is offering assistance to a large number of students through free loan and subsidized third party rental schemes.

The average net cost of assisted access schemes to the University from 1996 to 2001 is estimated to be £2.2m per annum.

CONCLUSIONS

The Open University is beginning its second quarter century at a time when communications and information technologies are undergoing a period of major change. This change appears to offer the University and the higher education community as a whole an opportunity to enhance the quality of its teaching material and to extend its geographic reach.

In particular, learning enhancement will come about through the creation of integrated multimedia learning environments. These environments will allow institutions to use a rich mix of media types in a more coherent manner. This opportunity will only be taken, however, if the community is able to begin the process of academic renewal. The core of a university's teaching emanates from its academic community. Only when the new technologies are seen by that community to be an essential part of their work, will an improvement in the quality of the education process begin to be seen.

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A MODEL PROGRAM:

DISCIPLINE-SPECIFIC INSTRUCTION

FOR

GRADUATE

TEACHING ASSISTANTS

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INTRODUCTION

In the past 25 years, science education has experienced a paradigm shift from behaviorism to cognition. Science educators are looking for an alternative to the traditional positivist's view that teaching is the transmission of objective knowledge and that learning is the objective absorption of knowledge. As Shymansky and Kyle (1992) explained, a constructivist epistemology underlies much of the current reform initiative in science education. Constructivism implies that learners are actively constructing their reality of the world.

This paradigm shift has placed new expectations on our future science teachers in higher education. Teaching in science is no longer simply telling, it is understanding the learner and implementing teaching methods that focus on conceptual changes in student understanding of scientific thought. With this paradigm shift, a renewed interest in science teaching practices in higher education is occurring, causing a need for graduate teaching assistants in science to understand the new conceptions of effective teaching.

The widespread use of graduate students as college science teachers has created concern for their preparation. Not only are these concerns voiced by university administrators who are demanding classroom accountability (Carroll, 1980), but also by those outside the university as well. The America 2000 program and the report, *A Nation at Risk* (National Commission on Excellence in Education, 1983) has brought educational concerns to the forefront of public opinion (Anderson, 1992). As a result, many academic science departments are rethinking their approaches to graduate students' preparation to teach. Researchers have also responded to these situational factors by focusing more attention on graduate students' instructional programs.

Today, graduates are expected to be well versed in teaching methods, as well as subject matter knowledge, in order to obtain employment in higher education. This necessity of preparing future graduates to be effective teachers is both a marketing and an educational issue. As Staton and Darling (1989) observed, the very fact of being a graduate student influences the thoughts and feelings graduate students have about the institution, as well as their future choice of career emphasis and concentration when they join the ranks of the professorate.

If graduates are to keep up with the expectations of the cognitive paradigm and obtain the ability to gain employment, then they must be instructed in pedagogical theory in direct combination with their subject matter knowledge. Research suggests that there is even more at stake. Graduate students play a significant role in helping to define and strengthen the overall quality of teaching in the university and, in effect, the university itself.

Shulman (1986) has criticized research on teaching for making the assumption that the teaching of any one subject is like the teaching of any other subject. An examination of different disciplines reveals that the nature of knowledge in different domains is not the same. The concern is that there are fundamental differences between content domains, and with this concern comes the realization that subject matter dependent instructional strategies are required (Finley, 1995). In addition, research on teaching indicates that teaching is a complex cognitive skill, a skill that requires the construction of plans and the making of rapid on-line decisions (Leinhardt & Greeno, 1986). The implication of the cognitive paradigm on college science teaching has important ramifications in preparing our future teachers to teach science.

The population of science teaching assistants at most universities is graduate students majoring in science disciplines. These teaching assistants instruct the majority of undergraduate science laboratories and discussions (Moore, 1991; Travers, 1989).

Many of these teaching assistants have had little or no prior instruction or experience in pedagogical theory or teaching (Monaghan, 1989). They are left to rely on their own experiences as students and whatever minimal instruction they may have received. According to Wilson and Stearns (1985), it is quite common for the emphasis of instructional sessions to be on the subject matter, while pedagogy is given little attention. These researchers maintained that teaching assistants would prefer more help with the *how tos* of teaching.

Instruction for teaching assistants does exist in most departments and at most Universities. However, it is usually little more than a review of course materials and procedures. If teaching assistants follow typical patterns, they will teach as they were taught, and continue without the benefit of understanding current research and theories about teaching strategies that help students construct knowledge.

If instruction provided by teaching assistants is to improve, they will need to learn the basics of pedagogical theory. More specifically, recent research on teaching indicates that they must learn pedagogical theory that is directly related to the subject matter they will teach (Shulman, 1986,1987). The research also suggests that together with the broad information and assistance provided to teaching assistants through the university-wide program, teaching assistants need to have the kind of discipline-specific instruction that can only be provided at the departmental level.

The definition of pedagogical subject matter knowledge adopted in this study was that of Shulman (1987). Shulman (1987) says that pedagogical subject matter knowledge is the integration of both pedagogical knowledge and subject matter knowledge into the ability to use both in a way that is instructionally appropriate.

For example, teaching about evolution requires subject matter knowledge about biology, and it also requires a transformation of that knowledge into something a learner can understand. Through analogy and metaphor, through multiple representations, and through mechanisms that tie the topic to the students' own life experiences, subject matter knowledge may be transformed into pedagogical subject matter knowledge.

PLANNING THE DISCIPLINE SPECIFIC INSTRUCTIONAL PROGRAM

In planning the discipline specific instructional program, there was considerable effort to review the literature. Topics covered encompassed effective teaching in science--including measurement of teacher effectiveness, strategies for increasing teacher effectiveness, effectiveness of higher education science teachers using different approaches, and instructional programs for graduate teaching assistants.

In the review of the literature, it was determined that educators and researchers agreed that discipline-specific strategies were necessary for effective learning to occur. Integrating these findings resulted in the following list of strategies that appear important for beginning science teaching assistants:

1. An understanding of learner misconceptions in biology

2. An understanding of how pedagogy relates to subject matter knowledge

3. An introduction to alternative learning and teaching strategies in biology

    a. Cognitive change learning/teaching

    b. Inquiry learning/teaching

    c. Cooperative group learning/teaching

    d. Discovery learning/teaching

4. Discussion and practice on the use of multimedia presentations used in science education

5. An introduction and modeling of laboratory activities

The instructional program was systematically designed to incorporate these features. Participants in the instructional program were graduate students who will teach the undergraduate (non-majors) biology course. All graduate assistants were evaluated on their conceptions of teaching throughout the course. The evaluation included field notes, interviews, and a questionnaire designed to assess changes in the graduate teaching assistants' conceptions of science teaching.

THE INSTRUCTIONAL PROGRAM

At the University of Minnesota, the task of providing teaching assistants with discipline-specific instruction was developed and implemented. The undergraduate (non-majors) biology course was designed using the constructivist's learning theory. The constructivist's learning theory is based on the pedagogical theory that acknowledges that students hold their own conceptions about scientific topics. The teacher's role is to challenge the students' conceptions to help students change their conceptions to the current scientific conception. The instruction for the course was aimed at combining a specific pedagogical theory with the subject matter of biology. Since the graduate students needed to teach the course in a manner very different from the manner in which they were taught, they were instructed on the conceptual change teaching strategy that was used to design the course. The instruction provided discussion and practice on implementing the pedagogical theory of constructivism directly related to the subject area of biology. The instruction involved considerable effort, including a pre-quarter session of 16 hours, plus weekly three hour pre-laboratory sessions in which the graduate teaching assistants received supplementary instruction on the teaching theory and the subject matter to be taught.

This instructional program proved to be quite successful. Besides improving graduate teaching assistant's teaching performance, there was a change in their teaching knowledge toward pedagogical subject matter knowledge (Hammrich, 1994).

Instructional materials included a workbook given to each participant that contained an outline, objectives and activity pages to follow during the instructional program. Pertinent readings on teacher effectiveness were also included. Each graduate student actively participated in using multimedia presentations, discussing their teaching preferences, writing objectives, constructing test questions, and preparing lessons.

Procedures

The instructional program was presented fall quarter 1993 to the biology graduate teaching assistants. It was presented for three days, from 8:30 to 4:00 p.m., in the week before classes began. Four university faculty and two graduate students were involved in the dissemination of the information during the instructional program.

CONCLUSIONS

The instructional program described in this paper has been a very positive step in the confirmation of new graduate students in biology in their role as teaching assistants. Graduate students' conceptions of teaching have changed dramatically, and their teaching practices have significantly improved.

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IS TECHNOLOGY A SUBSTITUTE FOR PREPARATION IN CALCULUS I?

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INTRODUCTION

The computer revolution claims to permit students to place less emphasis on the technical computations of calculus so that more time can be spent understanding the mathematics (Stroyan, 1995). This possibility would seem to empower students not fully prepared for the challenges of hand computations normally encountered in their first calculus course.

The mathematics department at Concordia College has been working to integrate computers into the content of calculus by using *Mathematica* to perform many of the computations traditionally done by hand. This paper attempts to address the question as to whether students really are empowered by the computer, and therefore more able to cope with basic calculus in spite of weaknesses in their preparation.

DESCRIPTION OF THE STUDY

At Concordia College, there were 275 students in seven sections of Calculus I taught by four professors. These students are registered in one of two ways for Calculus I--either in Math 113 or Math 114, depending on their background from high school.

Students in Alberta must take Math 30 in grade 12 as a prerequisite for any university level math course. However, they also have the option of taking a second course, Math 31. Math 31 is an introductory calculus course at the high school level. It therefore should represent an improvement in preparation for calculus, particularly of computational ability, by comparison to a student that takes only Math 30.

Students who have taken ONLY Math 30 in grade 12, register for Math 113. Students who have also taken Math 31, register for Math 114. However, at Concordia College, these students are mixed together in the same classes and so cover calculus in exactly the same way. The differences in level of preparation are examined by comparing which course students have registered in to their performance in the course. If the use of computers empowers students, or in some way makes up for poorer preparation, then one of two outcomes should be realized. Student performance in the calculus course should not differ greatly based on background preparation; or the difference should be lessened by the availability of computers in the course.

Students were also asked to complete a questionnaire near the beginning of fall term 1994. Of the 275 students registered in Calculus I, 191 filled out the questionnaire. Questions relating directly to the level of computer preparation the students had (or perceived they had), are compared to their performance in the course, in an effort to understand the difference computers have made.

FINDINGS

Math 113 versus Math 114

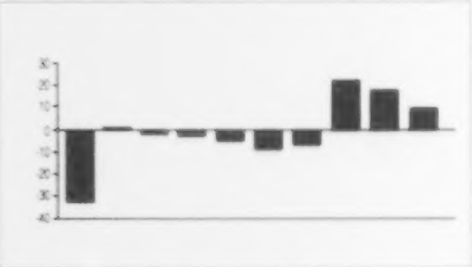
Since the preparation of students who have taken Math 30 should not be as strong as those who have also taken Math 31, it could be expected that the students registered in Math 114 would perform better than those registered in Math 113. This is indeed the trend that has been seen at Concordia College prior to the use of computers. The difference between the two groups has not always been large, but it has been evident. It was hoped that the introduction of the computer would enable weaker students to overcome some of the difficulties of calculus by relieving them of a number of the technical hand computations that are necessary to understand the concepts.
Course grades at Concordia College are given on a 9 point scale with 4 being the minimum for a pass. Table 1 shows the total number in each group, the percent that withdrew, and the median, mean, and standard deviation of those who remained in the two groups. It is obvious from Table 1 that the Math 113 students did not fair as well as the Math 114 students. It should be noted that there is a high correlation between students who take Math 31 and general math interest and ability.

Table 1. Statistics by Course Registration

Course	# of Students	Withdrew	Median	Mean	S.D.
M113	207	46.4%	5	5.31	1.84
M114	68	16.2%	7	6.96	1.88

Histograms of the percentage of students at each grade show a marked difference in the grade distributions between the students registered in Math 114 and those registered in Math 113. Figure 1 shows the difference between the two histograms and indicates clearly that the Math 114 students had a higher percentage of students at the higher grades while the Math 113 students had a higher percentage of students in the middle grades.

Figure 1. Difference Histogram of the Percentage of Students at Each Grade Including Withdrawal Rates



Note the first bar in the histogram. It reflects the finding that a greater percentage of students registered in Math 113 withdrew from the course.

The hypothesis that the means for the Math 113 and 114 students are the same was tested and rejected. A test of independence of the grade distribution and the registration showed them not to be independent. A test of the difference of withdrawal rates rejected the hypothesis that the rates were the same. The withdrawal rate for the Math 113 students was significantly higher than the Math 114 students.

Differences of these types are certainly not unexpected in view of the differences in preparation; however, if computer use really empowered students with a weaker background, then it would be hoped that the differences would not be so large.

The mean attained by one professor's students for the two years prior to the introduction of computers was compared to the mean for the three years after. There was no evidence to suggest that a change had occurred for either the Math 113 or 114 students. The mean for Math 113 remained virtually the same while the mean for Math 114 students went up slightly. The corresponding withdrawal rates for Math 113 indicated that they withdrew more frequently after the introduction of computers. The withdrawal rate for Math 114 students went up slightly as well, but did not show a statistically significant change. *The evidence appears to suggest that far from empowering students, the introduction of computers has made calculus more difficult.*

Effect of Computer Background

Surprisingly, prior formal computer training was found to have no effect on the mean or withdrawal rates. However, prior use of a word processing package did have an effect on the withdrawal rates of students. Perhaps the global skills learned with word processing activities are more strongly reinforced than other basic computer literacy skills (Beard, 1993). Figure 2 shows that students with word processing experience withdrew significantly less than those without experience.

Figure 2. Word Processing Experience and Withdrawal, All Students

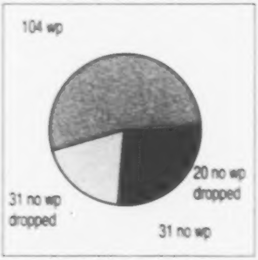
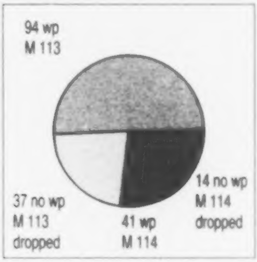


Figure 3 shows that the proportion of students with experience was almost the same for Math 113 and 114 students.

Figure 3. Word Processing Experience and Withdrawal, Math 113 vs. Math 114



CONCLUSIONS

Integration of computers into Calculus I does not appear to overcome differences in the preparation of students. Rather than making calculus easier by overcoming background deficiencies, it has made it more difficult for the students by adding an additional component for them to master.

Maxam and Stocker (1993) noted that many students need more than a cursory introduction to the computer to be able to successfully use it as a tool in course work. Perhaps it was wishful thinking to believe that computers would simply overcome poor preparation without a price, but it is still hopeful that weaker students will have a better chance of success in calculus using computers as a tool. However, this is certainly not the experience at Concordia College to date.

It is the general feeling of the instructors that the emphasis in Calculus I has sown change and will continue to change with the introduction of computers. More emphasis needs to be given to the conceptual understanding of mathematics--which is a welcome change. However, student performance shows the transition to be problematic.

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SCIENCE TEACHER PREPARATION: WHOSE KNOWLEDGE IS IT?

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INTRODUCTION

> *Knowledge helps us examine relationships between what is ethical and what is desirable; it widens our experience; it provides analytic tools for thinking through questions, situations, and problems. Knowledge that empowers centers around the interests and aims of the prospective knower (Sleeter and Grant, 1991, p. 50).*

Classroom demographics are shifting as well as the terrain of scientific and technological knowledge that defines the curriculum in science. In Florida, more than 40 percent of the students in public schools are students of color, and in 1993/94 there were 114,726 students whose first language was not English. Florida can expect another 70,000 students every year--that will require hiring 3,500 more teachers as well as the continuous need to build new schools (Orlando Sentinel, 1994). The challenge for educators is to deal with the increasing cultural, economic, language, and social diversity among students in order to provide an equitable education for the skills, attitudes, and knowledge that will allow them to be productive citizens.

Background

Teacher education programs at this author's university (University of Central Florida) provide backgrounds in educational foundations, curriculum development and instruction, various aspects of social components of educational practice, and teaching methodology. However, the only course in Multicultural Education is an elective offered for graduate students, and therefore the faculty and staff are encouraged to infuse multicultural topics into all education courses.

It appears that this strategy is inadequate to meet the needs of the university's students and teachers. Surveys of student interns and first year teachers from the past three years indicate that the need for knowledge and skills for addressing diversity issues is their primary concern. The work of this author is an effort to address this need by making connections between elementary and secondary science methods coursework and the realities of the schools and the students who attend them. It is important to assist teachers to develop a pedagogy that celebrates *diversity*.

A central belief is that knowledge alone does not change behavior and that knowing how culture affects us provides more choices as well as a deeper understanding of why students have different values, customs, and communication styles. Students must have multiple opportunities to understand the contradictory investments, commitments, and cultures of youth. Britzman (1991) suggested that as long as the education of teachers is defined exclusively in terms of work in individual classrooms, they will continue to have difficulties in creating relationships between knowledge and experience, and between schools and the larger social world. Teacher education programs need to include attention to and experience with youth cultures and the structures that sustain them.

The design of such science methods courses is grounded in the research related to transformative curriculum (Banks, 1991), democratic education (Beane, 1990; Kohn, 1986; McNeil, 1991; and Wood, 1988), and constructivist perspectives. The latter are built around the ideas that knowing is created rather than imparted or transferred, and that teachers must understand how students construct and use their understandings (Fosnot, 1989; von Glasserfeld, 1989). The approach is drawn largely from the works of Piaget (1954) and Dewey (1944) who proposed that people actively construct knowledge when they are offered numerous opportunities to explore phenomena or ideas, to predict, to reflect, and to revise their thinking.

Students in this author's science methods courses are required to document a minimum of 20 hours of community service. This requirement must be satisfied by working with minority and/or low-income children at sites including community centers, public school volunteer programs, the Compact Mentoring Program, Homeless Coalition, Boys and Girls Clubs, Center for Neglected and Abused Children, and others. The students are guided in their observations by the topics addressed in the science methods courses, by participation in weekly discussions designed to make meaning of these experiences, and by maintaining a reflective journal that is shared with their instructor.

The purpose of this paper is to describe service learning as a way to strengthen multicultural understanding in science teacher education courses. Results from these studies indicate that changing prospective science teachers' perspectives concerning teaching diverse students is difficult. However, as Banks (1983) has suggested, "... the position of the United States as a world leader demands that we deal more imaginatively and constructively with the enormous cultural differences within and outside our borders" (Banks, 1983, p. 559).

DESCRIPTION OF THE STUDY

Data collection methods were designed to illuminate the thinking and reflections of students enrolled in elementary and secondary science methods courses at a southern university. Data sources included formal and informal interviews with students, participant observations, and open-ended surveys. Artifacts and documents included student journals, portfolios, and other written documents that provided insights into the goals of the study. The study was initiated in September 1992 and continues as new data and insights are collected.

Data Analysis

Field studies methodologies involve the overlap of data collection and analysis. Categories were constructed from the voices of the informants, events, and documents. Matrices were developed to show relationships between emerging themes and categories. The categories that emerged from the data include: awareness of personal biases and stereotypes; awareness of how education can serve various political and cultural interests; and awareness of how dialogue and reflection serve to clarify understanding and uncover hidden agendas and perceptions.

FINDINGS

Presenting information to preservice students about societal inequities seldom enables them to examine their own beliefs and assumptions and think about how they influence the decisions they make. Additionally, merely presenting multicultural materials to preservice teachers does not take into account their preconceived notions or their readiness to learn.

Community service provided the students with the opportunity to interact with others who were different from themselves and with whom they might not otherwise have had contact in their daily lives. As the classes progressed, the data revealed increased student awareness of their own assumptions and how they might affect their teaching practices. In her journal, one student wrote:

> *Now that I'm leaving this class, I've lost my "rose colored glasses" and see things as they are. Students are unique individuals, colorful and full of life, with many dimensions and facets that reflect their cultural heritages. Now I see differences and I can appreciate what students can contribute to my class.*

The democratic, community-of-learners format of the classes offered students a place to share and openly discuss their experiences and perceptions. As pointed out by Pickles (1985), seeking the commonplaces, where student knowledge and teacher knowledge overlap, enhances students' abilities to connect reflection and action and provides a foundation for transformative education. This process allows students "...to build bridges among themselves; attending to a range of human stories, they may be provoked to heal and to transform" (Greene, 1993, p. 194).

For example, during a classroom discussion, a student stated:

> *This project gave me another look at my students through another pair of eyes, another perspective not clouded by my prior knowledge of my students. I learned a lot more about my students and myself during this project which has helped me relate better with my students.*

Other evidences of students' increased awareness of personal biases are found in portfolio reflections. The students are required to include a section entitled "Personal Growth", and over 70 percent of the students reflected about their increased awareness of the social issues and educational issues related to diversity.

One of the goals of the coursework is to assist preservice students to learn to create learning environments that reflect the realities of the students they serve, to gain a better understanding of the conditions that promote learning, and to connect science learning to students' life experiences and knowledge. Two students observed in their journals:

> *I guess what I have learned most in this class is that I am not only going to be teaching my students science but I will also be teaching them to survive in the world outside of the classroom.*

and

> *I understand that if we judge too quickly we might be wrong. The black female student that was initially a discipline problem in my class had no reason to trust me until I gave her one. And I assumed that her poor performance in class was due to lack of motivation. It was really because she was working until 3:00 a.m. each night.*

Of the unit lesson plans created by the students during the past six semesters, more that 60 percent of them showed evidence of realistically connecting science learning to student lives. For example, a unit plan on environmental studies centered on the involvement of students in a neighborhood clean-up co-sponsored by the inner city Neighborhood Ambassadors. While relevance is a requirement for the plans, some of them also showed evidence of little or no understanding of the realities of the lives of low-income or minority students, but rather framed the activities within their own realities.

Community-building was a part of every class period, and opportunities for student reflection were numerous and varied throughout the course. Some students commented about how this was important to make meaning of their learning experiences:

> *I learned a lot from [the course] but being* **part** *of a class where I made choices and decisions. I was treated fairly, I was a part of the construction of knowledge. I was given the chance to* **re-do** *assignments—I learned how to learn.*

CONCLUSIONS AND RECOMMENDATIONS

Friere (1970) stated that you must begin with the experiences of the actor, and in my courses, the actors are predominately white females who have come from economically privileged, culturally homogeneous backgrounds. They are generally unaware of their intellectual biases and have thought little about the need for social change. Community service offers a context in which to examine social knowledge because as Heaney (1984) observed, "Consciousness of oppression cannot be the object of instruction, it must be discovered in experience" (Heaney, 1984, p. 118).

One advantage of the community service experience is that it offers preservice students multiple opportunities to experience the lives of others who are different from themselves, while simultaneously engaging in ongoing discussions, reflections, and inquiry. The preservice students are encouraged to explore ways of bridging school knowledge and students' cultural knowledge. When designing science lessons, they are encouraged to ask themselves, "Whose knowledge is it?" The strength of the community service experiences within the framework of the science methods courses is the utilization of reflection and dialogue as vehicles for understanding, thinking, and planning for instruction.

Community service as an avenue to preparing teachers to teach in diverse classrooms, is only one of the many answers that holds promise for reaching the goal of making "...teaching and learning for understanding available for everybody's children" (Holmes Group, 1990, p. 29). The initial findings of this study suggest that community service can be integrated into the curriculum to strengthen multicultural understanding. However, it is also clear that a foundation course in multicultural education would strengthen and enhance the process of understanding and broaden the scope of dialogue.

Beyond recruitment and selection, questions of teacher education reform must continue to promote examination of what prospective teachers do, as well as where and when they do it. This study raises important questions about how community service experiences are translated into practice during student teaching and into teacher practice. If this is the only experience directed at understanding equity and social justice, what will be its impact?

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LEARNING TO TEACH ON TELEVISION: IMPLICATIONS FOR BEGINNERS

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INTRODUCTION

Despite its rapid growth, instructional television is not yet a dominant mode in higher education, and so most faculty have little or no experience teaching via television. And teaching by television differs in important ways from "regular" classroom teaching (Gelhauf, Shatz, & Frye, 1991). Faculty, for the most part, have to find their own solutions to the demands and limitations of the medium (Egan et al., 1992; Souder, 1993; West, 1994; and Wolcott, 1993).

A recurring theme in distance education is the tension between the opportunities of interactive television and faculty's resistance--and even fear--of the new technology (Barker & Dickson, 1994; Gunawardena, 1990). A powerful way to promote adoption and advocacy of instructional television is to help faculty have successful, gratifying experiences with it. These authors looked to faculty learning to teach on television for insights on how to help future teachers new to this type of instruction to better adapt to and benefit from the new medium.

DESCRIPTION OF THE STUDY

Telephone interviews were conducted with 42 faculty who had taught on television in the past three years. These faculty included all ranks, and ranged from novices to veterans who had taught five semesters using the medium. The core of the interview questions was standardized. However, the major interest was in getting faculty to talk freely about their experiences with interactive television rather than in comparability of responses. Faculty responses were probed freely.

Faculty were asked to compare teaching on television to regular teaching in the following ways: 1) did they prepare differently for teaching on television?; 2) what preparation did they receive for such instruction?; and 3) did they discover any practical tips that would help novices? Notes were recorded of responses, and responses were examined for patterns and themes, with the goal of identifying considerations for future faculty development.

FINDINGS

The questions elicited fluent responses from almost every person. Faculty were willing and even eager to discuss their experiences with instructional television and went far beyond the literal scope of the questions. For example, faculty were not asked to identify problematic areas, but they volunteered issues with which they had struggled.

The topics generated by faculty fell into three broad categories: 1) technical skills and logistics; 2) emotional/attitudinal factors; and 3) faculty development of self and others.

Technical Skills and Logistics

The great majority of faculty found teaching on television very different from "regular" teaching. They cited three problematic areas: 1) *preparation* (time, degree of detail, design of instruction, how/what to prepare); 2) *teacher's communication to students* (graphics, handouts, speaking, posture, position, use of equipment, sending materials to sites, equipment and production malfunctions); and 3) *two-way communication* (student participation, group work, questioning/discussion, hands-on activities).

Preparation. The main logistical issue was greater preparation time. Faculty reported two to four times as much time preparing for teaching by television as for the same course in the regular format. They had to prepare lessons in much greater detail, to prepare further ahead, and to prepare more materials for students--all of which reduced the instructor's flexibility and spontaneity.

Teacher's Communication. The second set of logistical concerns derived from the loss of the chalkboard. Faculty missed the ability to put up lots of information for their students as discussion progressed, and to have it visible for later reference. Associated concerns were the inability to get a long equation on the screen, having to shuffle from one display of information to another, figuring out what students were viewing, lag time in sending and receiving materials from sites, and frustrations with equipment.

Two-way Communication. The third large logistical issue was getting students to participate, with faculty perceiving students on and off campus as more reluctant to speak on television, combined with time lag and awkwardness in hearing from off-campus students. Associated with this was difficulty of conducting questioning/discussion, group work, student reports, and hands-on activities.

Emotional/Attitudinal Factors

Faculty appeared to define the task(s) of teaching on television as teaching the regular course as best they could in constrained circumstances. Only one faculty member volunteered an advantage to instructional television--that he did not have to show videotapes himself.

Faculty responses displayed strong emotion and varied widely in the coping tactics expressed. A few faculty declared that they refused to do anything different for television; some fretted about their performance; and some described the experience as personally renewing and beneficial to all their classes. Most expressed interest, and even excitement, about learning to adapt to a new situation. Most were very positive about the experience; a few expressed negative attitudes.

The emotional/attitudinal factors cited fell into three areas: 1) *effectiveness concerns* (faculty's not knowing whether their instruction on television was as effective as regular instruction); 2) *practical sources of frustration* (various obstacles and the extra time commitment); and 3) *personal insecurity* (concern about appearance, feeling awkward and unskilled, stage fright).

Faculty Involvement in Development of Self and Others

Faculty clearly exhibited problem-solving strategies and had both general and specific advice for novices. Some faculty had discovered techniques like those found in the literature. They had also developed original ideas, different solutions to similar problems, and variations for different contexts. For example, faculty had found multiple ways to present information, encourage students to participate, and guide students through *their* new experience.

IMPLICATIONS FOR FACULTY DEVELOPMENT

Based on faculty interviews, six recommendations are listed below for faculty development programs for teachers beginning to use instructional television.

1. Provide release time and/or other substantial support for faculty teaching on television. This recommendation is commonplace; however, it bears repeating because some administrators still do not understand the demands of instructional television.

2. Provide systematic teaching of technical skills and logistical arrangements to faculty. This recommendation is also common sense; however, faculty need, in addition to coverage of these topics, thorough teaching and follow up.

3. Give special attention to helping faculty develop multiple ways to present visual information. This area was of particular concern in faculty's responses, and faculty appear to need substantial support and consultation about graphic materials.

4. Give special attention to helping faculty develop multiple ways to sustain participation from all students. Again, this was a prominent issue in faculty's responses and showed their concern for good two-way communication.

5. Give special attention to faculty's emotional/ attitudinal needs. This area is critical to eventual satisfaction with the new technology. Orientation should include considerable practice--perhaps lessons in moving and presenting on television. Coaching, viewing tapes for self-critique, supportive contact with peers, feedback, and reassurance would also seem to be of benefit.

6. Involve experienced faculty as full partners in providing faculty development.

SUMMARY AND CONCLUSIONS

The majority of faculty interviewed were enthusiastic and interested in their experiences with instructional television. They also discovered and tested a variety of strategies. Involving them in development of novices and each other would promote a body of knowledge to strengthen future practice.

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INTEGRATING SCIENCE AND HUMANITIES: REDEFINING THE PREPARATION OF ELEMENTARY TEACHERS

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INTRODUCTION

This article describes the development of an innovative, eight semester-credit hour course block for Elementary Education majors. This course unites science and the humanities to prepare future elementary teachers to teach the content of science through history, literature, and philosophy to elementary school students.

RATIONALE FOR CHANGE

Reports generated by the National Science Teachers Association (1992), and the National Research Council (1989) identify problems of large numbers of undergraduate non-science majors who are typically "programmed for either flight from or disaster" in their encounter with science.

Many of these attitudes toward science are in danger of being passed on by elementary education students to the elementary students whom they will later teach. Even when undergraduate education students have positive experiences with science, they often cannot translate these experiences into motivational and integrated activities for elementary school students.

The crisis in science education and concern for science literacy in our public schools is well documented. In *Science For All Americans* (Rutherford & Ahlgren, 1990) the American Association for the Advancement of Science suggests that present methods of instruction and science textbooks actually impede learning.

Science education too often consists of a series of fragmented and unrelated parts--a set of facts to be memorized. Study in the humanities provides part of the common core of learning needed for scientific literacy that will produce long-term benefits for both elementary students and their future teachers who will be personally and professionally enriched.

While effective teachers recognize that students are more motivated to learn through such techniques, the typical teacher education curriculum has done little to prepare future teachers for this challenge.

COURSE DEVELOPMENT

AND IMPLEMENTATION

During the summer of 1995, the Education Department of Susquehanna University developed a new curriculum to meet this challenge. As part of the new curriculum, an integrated course in science and humanities was collaboratively developed. The organization of the course, as well as much of the cognitive dimension of the course, reflects an understanding that science is one of the liberal arts and should be taught as such. The unifying themes and intellectual relationships which connect science to other disciplines in the liberal arts are explored in each of the course units.

Each of the units features team activities, discussions, drama, children's literature, and hands-on experiences. Such experiences are focused on the teaching of integrated units capped by a review of important language arts and social science perspectives. At the same time, students are introduced to an innovative scientific curriculum of hands-on collaborative investigations and demonstrations through participating in a series of laboratory sessions.

The course emphasizes the explorations of questions rather than answers, critical thinking, understandings in context over recitation, and doing in lieu of reading. Faculty teaching the course demonstrate the integration process throughout each course unit.

The course differs intentionally from the typical elementary science education course in a number of ways. Most science education classes emphasize teaching methodology over subject matter frameworks. Rather than requiring sampling of content from science disciplines to illustrate specific teaching methods, this course seeks to impart understanding first through the development of key concepts in several disciplines. Each discipline has a well-structured knowledge base, but this structure is seldom explained to students who will later be teaching it. The Integrated methods course describes and explores subject matter and discipline structure, ideas that transcend disciplinary boundaries, and understanding the intellectual relationships among discipline structures.

Four integrated units were developed by seven liberal arts faculty to serve as models for students in the course. These units (Sun, Castles, Dinosaurs, and River) illustrate the connections among disciplines in science and humanities. The units serve as a guide for the development of similar student team units to be presented to the class. Four members of the class comprise a team to develop and write integrated units to be taught to the class. The units are evaluated through peer review, faculty evaluation, and self evaluation. Units use a well-developed lesson plan structure and are analyzed for style, spelling, and syntax. Seven liberal arts faculty from multiple disciplines serve as content specialists and consultants for the integrated units.

The course has a seven week practicum at the Selinsgrove Elementary School. The hours of the practicum extend from 8:00 a.m. to 2:00 p.m. on Tuesday and Thursday. During the practicum, students develop and teach an integrated thematic unit to children. Two students are assigned as a team to one classroom at the elementary school. The students develop and teach an integrated unit on a topic that is jointly determined with the classroom teacher. The unit activities reflect the dimensions of learning developed in the course.

COURSE UNITS AND ACTIVITIES

Course units are developed around six dimensions of learning, as described by Marzano, et. al., 1992):

Unit 1. Perceptions About Learning. Perceptions about learning are reflected in all human societies in the present, past and future. Perceptions and attitudes affect learning in important and fundamental ways. A primary focus for effective instruction is to understand and establish positive attitudes and perceptions about learning.

Unit 2. Acquiring Knowledge. New knowledge has been acquired and assimilated by every human society. This unit explores how human societies and individuals acquire and relate new knowledge to prior knowledge in meaningful ways.

Unit 3. Extending Knowledge. Learners extend and refine their knowledge, adding new distinctions and making further connections based on what is meaningful to them. This unit explores the impact of cultural context on learning, and develops understanding for extending and refining knowledge in diverse settings.

Unit 4. Integrating Knowledge. Meaningful relationships and connections help guide understandings, create images of new concepts, and help students acquire and retain new knowledge and attitudes more effectively. This unit emphasizes making connections between teaching methods, the disciplines, and children's lives.

Unit 5. Productive Habits of Mind. Productive habits of mind are used by critical, creative, and self-regulated thinkers. This unit helps future teachers develop mental habits in students that will enable them to learn on their own, solve problems, and develop critical thinking skills.

Unit 6. Applying Knowledge Meaningfully. Most effective learning occurs when students are able to use knowledge to perform meaningful tasks. This unit applies course concepts to a practicum in which students will develop and teach thematic integrated units in a public school.

Postholes - Dealing With Time Dimensions

Patterns of change over time are of special interest in the humanities and science. Patterns of change were explored by examining evidence (postholes) from a particular culture at a specific point in time. In this course the dimension of time was also sequenced differently from the usual past, present, and future orientation. As children's activities and ideas are often rooted in the present, activities began with the present, considered the past in relation to the present, and predicted what may occur in the future.

Including Other Voices - Women Scientists and Healers

Women in science have had special obstacles to overcome. In order to tell the inspiring stories of women who have set a new standard of excellence in their field, student teams developed a 30-minute dramatic interpretation and/or short skit that illustrated science content and the contributions of women.

PRELIMINARY EVALUATION DATA

Students admitted to the education program are required to have a cumulative grade point average of 2.67 (B-) in order to take the course. Eighteen students enrolled in the course. Data from the interim project report and the student opinion of instruction indicated the course was highly successful in accomplishing its stated goals.

Students were required to write in a reflective journal after each class to provide feedback and evaluation data. Student suggestions were incorporated into the course development. In particular, the time schedule was adjusted to include an adequate lunch hour. Laboratory sessions were also held on Saturday.

Student opinions of instruction ranked the course in the highest range. Student comments were extremely positive, although they complained that the course was time intensive and required a great deal of work. All students successfully completed the course with a grade of B- or higher. Course evaluations are given in Table 1.

Table 1. Course Evaluations

Evaluation Progress Ratings	Percent Responding				
	Low				High
	1	2	3	4	5
A. Subject Matter Mastery					
Factual Knowledge	0	0	0	0	94
Principles and Theories	0	0	0	0	94
Professional Skills	0	0	0	0	100
B. Development of General Skills					
Thinking/Problem Solving	0	0	0	0	100
Creative Capacities	0	0	0	0	100
Effective Communication	0	0	0	0	78
C. Personal Development					
Personal Responsibility	0	0	0	6	94
General Liberal Education	0	0	0	11	89
Implication for Self Understanding	0	0	0	17	83
D. Self Ratings					
Improved Attitude Toward Field	0	0	0	11	89

Note: N=18 (100% of enrollment)

SUMMARY AND CONCLUSION

The Integrated Science and Humanities Methods Course for Elementary Teachers was collaboratively developed by nine faculty, eight teachers and 18 students. It was comprised of six units of instruction and a seven week practicum in a public school. The course explores understanding connections among disciplines in the science and the humanities in the intellectual contexts in which they arose. Such connections help learners construct their own knowledge and develop their own cognitive maps of interconnections among facts and concepts. This cognitive view calls for a constructive approach to learning in which the whole is greater than the sum of the parts. Understanding these connections and their implications for improving learning is expected to help future teachers develop more productive habits in their students.

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WILL SUCCESS SPOIL DISTANCE EDUCATION?

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INTRODUCTION

Not too many years ago, media-based higher education delivered off-campus was called "alternative learning systems," or just "off-campus programs," and represented a relatively small part of higher education in the United States. Mainstream higher education occurred in classrooms and on campuses. With 3,000 two- and four-year colleges and university campuses spread all over the country, students were recruited to come to campus. While some potential students in remote areas needed correspondence courses or other alternative access in order to be able to pursue college degrees, it was generally accepted, until recently, that the country would be able to build facilities to handle the demand.

Recent developments are changing the common understanding of what higher education institutions should look like, and are also changing the process of teaching and learning. These developments include the explosion of new communications technologies, the need for life-long learning, and the declining financial resources available for construction of traditional campuses. These have contributed to a dramatic interest in, and experimentation with, "distance education."

THE GROWTH OF DISTANCE EDUCATION

IN THE UNITED STATES

Exploration of the use of media to deliver higher education began with the inventions of radio and television; however, large-scale distance education programs were not undertaken until the 1950s. They have continued in each decade since then.

The interest in "open learning," found in single-purpose institutions in other countries, did not develop in the United States. Instead, many different institutions experimented with media-based, off-campus education. As Miller (1989) explained, the multiple levels and diverse missions of higher education institutions in the U. S. resulted in distance education emerging as one of many ways diverse institutions serve their communities.

Today, two- and four-year institutions, public and private, large and small, and in every state, are experimenting with distance education. A look at the topics of recent conferences of The College Board, the American Council of Education, the American Association of Higher Education, the American Association of Community Colleges, and many others, reveals an intense interest in distance education. Many state and national reports and policy statements have examined the merits of distance education as a way to "solve" diverse problems facing higher education such as access, adult illiteracy, the need for life-long learning, and continuing education (Roberts, 1989; Commission on Innovation Report to the Board of Governors of the California Community Colleges, 1993).

Exact numbers are difficult to find, but all indications are that the number of institutions offering distance learning programs and the number of students enrolling have grown steadily. The Instructional Telecommunications Council survey of community colleges showed that in 1990, 58 percent had distance learning programs, and another

20 percent expected to offer such programs in the next five years (Brey, 1991). Enrollment in telecourses, probably the most popular form of distance learning, is reported by PBS to be over a half-million students a year and growing. Counting enrollment in telecourses distributed through other systems or produced and offered locally brings the total to over one million.

One of the most important trends in distance education programs in the nineties is the commitment to offering full degree or certificate programs via distance education. Instead of just offering a few courses in a distance learning mode, colleges and universities are creating distance learning degree tracks at all levels. The publication, *Going the Distance* (Annenberg, 1992), from the Annenberg/CPB Project and the PBS Adult Learning Service, provided a handbook for developing distance degree programs using television courses and telecommunications technologies. In fall 1994, the PBS Adult Learning Service announced the establishment of the "Going the Distance" initiative of over 60 colleges and 20 public television stations which would offer A.A. degrees using distance education courses (DuBois, 1994).

At the upper division and graduate level, many noteworthy institutional and consortial efforts to offer distance education currently exist. The International University Consortium was first created in 1980 by the University of Maryland to expand the number of courses available as distance learning offerings. The Consortium now includes 27 institutions and acquires, adapts, and produces media-based distance learning courses. It also provides training and support for its member colleges.

The National Technological University (NTU) provides satellite-delivered courses at the graduate level to students, many of whom are employed by major national corporations. Students can receive degrees from a number of institutions which have articulation agreements with NTU. A private venture in upper division and graduate distance education comes from Mind Extension University

(MEU). MEU is part of Jones Interactive, Inc., which distributes the courses to cable companies. Students receive credit from a group of cooperating colleges and universities.

The expansion of distance education is also apparent in the growing collection of research and training materials. The Association of Educational Communications and Technology (AECT) offers summer training workshops in distance education, and the Instructional Telecommunications Council has a guide to distance education for college presidents (Gross, Muscarella, & Pirkl, 1994), as well as other resource materials. Articles reporting research findings and exploring theoretical issues can be found in *The American Journal of Distance Education*. Since 1987, Hezel Associates has studied how each of the 50 states coordinates the planning of technology, with special attention to the use of telecommunications for distance education (Hezel, 1992).

ISSUES IN THE OFFERING OF DISTANCE EDUCATION

As the numbers and kinds of distance learning programs grow, so do questions and issues. What was earlier seen as an alternative delivery system to help adults and non-traditional students have access to higher education is now being considered as a viable delivery system for mainstream students. This raises questions about quality, effectiveness, and operations. The following is a brief description of four issues facing distance education practitioners.

Import or Originate?

Because many institutions have been developing distance learning courses, colleges find they have a choice about whether to originate their own courses or to acquire courses from another institution. This question applies to both live and pre-produced courses since satellite and phone lines go across geographic and jurisdictional boundaries. While acquired courses may not fit all colleges' curriculum plans, cost and concern to maximize effort suggest that if another institution has designed and developed a good quality course, then why duplicate it? Models of acquisition of courses which permit adaptation or modification need to be developed to allow for the best balance of institutional control of curriculum while reducing unnecessary duplication.

Live or Recorded?

The issue of whether to offer live or pre-recorded distance learning courses is related to, but not the same as, the "import or originate" issue. Community colleges, which have utilized pre-recorded telecourses more extensively, have benefited from the availability of high quality courses that are designed and produced to meet many colleges' needs. At the upper division level, fewer pre-produced courses exist, thus the issue of live versus recorded has been less debated.

However, for some university faculty, the issue is a philosophic one which relates to a basic function of faculty to create and teach courses. Some professors oppose even the recording of their own live distance learning efforts, perhaps fearing exploitation or even job loss. In other institutional settings, faculty have found that recorded course components, like textbooks, can relieve the instructor of a burden of basic transmission of information, freeing them to be more responsible for standards, evaluation, interpretation, and student advising.

Faculty-Centered, Media-Centered, or Student-Centered?

As more individuals and institutions become involved in distance education, faculty and staff discover the excitement of working with media. A desire is created to use the newest technologies, raising the cost and, in many cases, lowering the productivity of distance education. One of the primary goals of distance education --access--can easily be subverted if students do not have access to the new technologies or do not know how to use them. And, if students have to come to campus to use a multi-media laboratory, then the advantages of "distance" education may be lost.

In undertaking distance education, institutions have to determine whether the goal is to explore applications of the media, encourage faculty development, or serve students. Experimentation with the instructional potential of new media is a valid and important goal, but it may not be compatible with providing higher education to more students at less expense. As Graves (1994) observed, "Missing [from efforts to utilize technology for learning] is a systematic approach to combining these technologies in pursuit of educational quality and to containing the costs of a learner-centered instructional environment" (Graves, 1994, p. 32).

Which Technology and Who Controls?

One obstacle to institutions adopting media-based distance learning systems has been that most educational leaders do not have a good understanding of media production and media distribution. They find that distance learning may be dependent on public or cable television or telephone companies for distribution, with little background on either side to build a cooperative service. Using media for distance education is forcing institutions to look into new partnerships with public television, cable television, telephone companies, and hardware and software producers to bring some control and predictability into the business of distance education.

Thirty years ago, a college's infrastructure was buildings and utilities and print materials. Increasingly, the infrastructure is also telecommunications systems which involve educators in complex local, state, and federal policy and discussion of regulations. As Doucette (1994) observed, colleges have to be willing to invest in the technologies which will be the underpinnings of not only the instructional effort, but also of administrative systems, communications, and information resources.

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COLLABORATIVE PLANNING TO IMPROVE HIGHER EDUCATION: SYSTEM-WIDE AND CAMPUS INITIATIVES

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INTRODUCTION

The establishment of professional development programs of centers of teaching and learning is an important way in which higher education can be improved. Realistically, however, such centers can be successful only to the extent that a close collaborative working relationship exists between administrators and faculty.

Both of the above groups must recognize the primacy of teaching in undergraduate education, view faculty professional development as a high priority in furthering the improvement of teaching and learning, and commit their energies toward the development of policies and programs that seek to accomplish these objectives. The administration plays an additional key role in the provision of fiscal resources, in the support of personnel positions required to administer/coordinate faculty development programs, and for the many and varied activities and projects sponsored by such a center.

Crucial to the success and effectiveness of a teaching and learning center is the extent of faculty involvement at every step in its development. Be it at the system-wide or campus level, the development of any center for improving teaching and learning requires substantial and continued faculty participation. The development of the goals and priorities of the program, the types of projects and activities for faculty development, and the dissemination of information to faculty need to be primarily the responsibility of faculty. Advisory groups, composed largely of faculty but with representatives from the academic administration, are necessary to recommend policy to both faculty governance bodies and to the administration, and to continually maintain involvement in effective programs and develop new faculty-driven initiatives.

The remainder of this paper will describe how teaching and learning is enhanced throughout an entire university system through activities of a system-wide institute and local campus centers (Cohen, 1988).

THE SYSTEM-WIDE INSTITUTE

The Institute for Teaching and Learning in the California State University (CSU) system is an example of a system-wide initiative. The 22-campus system has an enrollment of 320,000 students and 16,500 faculty. It is the largest post-secondary educational institution in the United States, spreading over 150,000 square miles.

The CSU educates 70 percent of California's public school teachers and 10 percent of the nation's teachers. It has great ethnic diversity in its student body reaching groups that have traditionally been under-represented in higher education, such as Hispanic, African Americans, Filipinos, Pacific Islanders, Cambodians, and Vietnamese. To educate California's students is a great challenge; the need for excellence in teaching is high.

Each CSU campus has an academic senate composed of faculty and other constituents which forwards recommendations to the president for approval and implementation. Each campus also sends faculty representatives to the system-wide senate, known as the Academic Senate of the California State University, that forwards recommendations to the CSU Chancellor and Board of Trustees.

Development, Governance, and Goals of the Institute

During 1985-1986, the system-wide academic senate undertook an in-depth and critical evaluation of undergraduate education in response to a number of national reports on the crisis state of U. S. education. One of the major recommendations of that self-study, which reaffirmed the primacy of teaching in undergraduate education within the CSU, was the creation of a system-wide institute to make a significant contribution to the improvement of teaching and learning.

Three goals were identified for this new institution: 1) to sponsor research into the processes of teaching and learning in higher education; 2) to emphasize research into the implications of student diversity on learning and into improved methods for teaching nontraditional students; and 3) to publish a journal devoted to disseminating research findings concerning teaching and learning in higher education (Cohen, 1988). The recommendation was endorsed by the Chancellor, and the Board of Trustees soon approved the creation of the system-wide Institute for Teaching and Learning. The

Chancellor allocated system-wide funds for the Institute's programs and for a faculty director to coordinate the Institute's activities and other support staff.

The charter of the Institute called for governance by a Board of Directors co-chaired by a faculty member and the Senior Vice Chancellor for Academic Affairs. The Board was designed to consist of five faculty, two presidents, two vice presidents for academic affairs, and the system-wide Vice Chancellor for Human Resources and Operations.

The Chancellor and the Chair of the CSU Academic Senate jointly appointed an Advisory Board charged with developing the mission, goals, and programs of the Institute. The mission statement, revised in January 1994, states that the primary mission of the Institute for Teaching and Learning is to provide assistance and resources in support of the highest standards of university teaching excellence and to provide support for faculty members to grow professionally.

The Institute, under the guidance of the system-wide advisory board, works with CSU campuses to stimulate the interests and promote the involvement of faculty members in improving the university teaching and learning process and in engaging in scholarly and creative activities. Further, the Institute fosters and supports faculty research that contributes to effective teaching and learning in and across the disciplines. Emphases include different learning styles and effectiveness of various university teaching strategies with diverse and changing student populations in a multicultural environment.

The Institute also works with campuses to develop mechanisms for system-wide sharing of resources in instructional and professional development and for system-wide dissemination of university teaching, learning, and professional strategies. In this regard, the Institute oversees the coordination of campus faculty development directors. In sum, the mission of the Institute is to support faculty at all levels in their efforts to improve teaching and learning. This is done by facilitating exchanges and dissemination of information, engaging in scholarly activities, encouraging disciplinary and interdisciplinary activities, and, as a special focus, by developing effective strategies for teaching students with different learning styles from diverse and multicultural backgrounds.

Institute Activities

Since its establishment, the Institute has sponsored a number of statewide conferences. These conferences bring together faculty from all campuses to form discipline seminars. Within this seminar framework, faculty can discuss teaching and learning strategies and pedagogical issues, can share information on a continual basis through the establishment of a disciplinary newsletter, and can develop system-wide discipline-specific based research on teaching effectiveness.

In addition, the Institute also sponsors an annual Teacher-Scholar Institute, a four-day retreat for faculty to engage in extended workshops and discussions. This year's topics included:

Using Metaphors to Discover Your Teaching Self

Strategies for Chaos

Transforming the Large Class into a Real World Experience

Two-way Video Classes--Design and Delivery

Using Hypermedia in Instruction

Strategies for Promoting Active Learning Within the College Classroom

In all these activities, the Institute funds faculty attendance. It also depends heavily on the expertise of faculty in the system to lead workshops, seminars, and other presentations.

For the past five years, the Institute has co-hosted the Lilly West Conference on College Teaching and Learning. The Institute has also sponsored two other major conferences, one of which was at the national level, on the teaching and learning exchange. The Institute is planning another national conference in the 1995-1996 academic year.

To further expedite communication among CSU faculty, the Institute publishes biannually, *Exchanges*, a newsletter sent to all CSU faculty. The newsletter presents discussions of pedagogical issues and strategies, book reviews, opportunities for faculty involvement in assorted projects, and announcements of conferences. Beginning last year, the Institute edits one issue annually of the *Journal on Excellence in College Teaching* to which CSU faculty submit articles. The Institute has also created an electronic network, ITLNET (itlnet@calstate.edu). Recently, the CSU Commission of Learning Resources and Instructional Technology assigned primary responsibility for faculty development in instructional technology to the Institute.

Like many systems of higher education, the CSU has experienced major budget reductions in the past five years. As a result, many Institute activities have either been reduced in size or put on hold. The Institute is searching for ways to meet the increasing needs of faculty and to involve more faculty than have been reached to date.

CAMPUS CENTERS

Development, Governance, and Goals of Campus Centers

At the campus level, as at the system-wide level, collaboration among faculty and administration is essential. Campus centers for teaching and learning should be the result of an extended planning process with heavy faculty involvement and representatives from top level academic administrators. This planning process, sometimes taking as long as one year or more, helps faculty identify which of the existing faculty development programs need to be retained, and what kinds of programs and services need to be developed for continued and expanded faculty development.

To ensure the campus center continues to be responsive to the faculty's needs, this planning group needs to seek and be responsive to ideas and suggestions from the faculty-at-large, to define the philosophy of the center, to establish program planning priorities and goals, and to respond to ideas from other constituent groups. Faculty participation from all departments is essential, not only to determine the development needs, but also to obtain faculty "buy-in." The critical factor is that *it must be a faculty-driven program* that exists to help faculty improve their instructional skills, to allow experimentation with new teaching strategies in a safe environment, and to stimulate and provide for the incorporation of new advances, such as the integration of electronic technology into the teaching and learning environment.

Campus teaching and learning centers must have the full support of the top administration--both the Provost of Academic Affairs and the President. A substantial and significant allocation of funds, on a continuing basis, is essential if the center is to exist and function effectively. The Provost for Academic Affairs at California State University, Chico, recently emphasized that for faculty to consider it worthwhile to become involved in center activities, the administration must also value it highly and support it financially. In addition, he stressed that the administration needs to provide funds that support faculty involvement and projects, such as participation in workshops, discussion groups, materials for libraries--and not just for the director and other administrative staff.

Organizationally, an all-university teaching and learning center should not be affiliated with any department, school, or college. Institutions that have housed such a center, for example, in the College of Education, oftentimes find the center focuses on research and assessment projects that quickly shift funds away from faculty development activities and ignore the teaching development needs of faculty. As a result, the center becomes marginalized and of little use to the professional development of faculty.

A campus center also needs to be an umbrella organization that not only has its own programs, but also coordinates with other worthwhile faculty development programs that are ongoing elsewhere on campus. However, centers should *not* attempt to take control over *all* faculty development activities on campus. Instead, according to the director of the very successful Faculty Center for Professional Development at California State Polytechnic University, Pomona, the center should strive to increase faculty participation in those programs and to provide assistance to faculty endeavors such as helping them write and revise grants and proposals that the other programs offer (e.g., sabbatical applications and grant proposals).

A campus center needs to be seen as a safe environment in which faculty can learn and experiment with new teaching strategies, methods, and instructional technologies. In order for this to occur, the center must be functionally separate from the retention, tenure, and promotion evaluation process. The center cannot be viewed as a tool for administrative evaluation and must be independent from student evaluation of faculty and other evaluation mechanisms. Faculty need to feel safe to succeed as well as to fail.

The above by no means implies that faculty cannot list and describe their activities and achievements from participation in faculty development programs in their dossiers. In fact, the center could, for example, provide sessions to faculty seeking help in developing dossiers and teaching portfolios. The center must be perceived by faculty as their source of support and development in their role as educators.

Campus Retention, Tenure, and Promotion Policies

There is a growing awareness in the academic community that retention, tenure, and promotion policies need to acknowledge, value, and include--in addition to scholarly and creative endeavors--scholarly work in the teaching and learning process itself as a valid contribution to evaluation of teaching. Many faculty are eager to learn about new teaching strategies, or are searching for ways to improve their teaching, and would like to conduct research evaluating the positive changes brought about by incorporating new techniques and technologies. They appreciate opportunities to attend workshops, conferences, and conventions to exchange information with other faculty on the teaching-learning process, yet they are distraught over the fact that their retention, tenure, and promotion policies do not recognize these activities as valid criteria for effective teaching and professional development.

Center Activities

The types of activities of teaching and learning centers are varied and endless. The primary ingredient seems to be to develop programs that enable faculty to work with, and learn from, each other--both within the discipline and across disciplines.

For example, in addition to a long list of on-going programs, Cal Poly, Pomona, uses quarter breaks for well-attended faculty workshops. Topics include active learning, hypercard development, integration of technology into teaching, and effective strategies in working with students. This year, California State University, Fullerton, hosted an eleven-campus Saturday symposium on university teaching and learning that attracted as many as 300 faculty from the Los Angeles basin. Participants shared strategies on successful teaching, new teaching techniques and innovations, and ways of integrating technology into instruction.

Many CSU campus centers serve as resources for faculty writing proposals ranging from local grants and sabbatical applications to state and federal grants. Librarians conduct workshops for faculty on access to electronic databases. The scope of programs that can be developed for the improvement of teaching and learning is virtually limitless, but will continue to be dependent upon collaboration among faculty and administration.

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GENERATING A POSITIVE STUDENT EXPERIENCE IN DISTANCE LEARNING EDUCATION

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INTRODUCTION

This article provides instructional suggestions for faculty preparing to teach distance education courses through a system equipped with a two-way interactive audio and video capability. When instructors engage in teaching through the use of such an interactive based system, they are faced with two fundamental challenges: 1) mastering the technology; and 2) working with students who might be overwhelmed by the technology around them. The first challenge can be mastered through practice. This article addresses the second challenge.

Creating an in-class, interactive environment will ensure that technology becomes a secondary factor of attention for students. An outcome in which students are engaged in a positive learning experience can thus be achieved. These recommendations, resulting from the author's experiences, are aimed at expanding interactive opportunities between students and instructors.

INTERACTIVITY AS A CRITICAL COMPONENT OF THE EXPERIENCE

The inclusion of interactive techniques to maximize in-class learning effectiveness is critical to the success of distance education. A state-wide task force on faculty issues in distance education in higher education (State of Illinois, 1993) reported that "teachers have to be able to reach out across the miles and develop a personal rapport with the students they serve" (State of Illinois, 1993, p. 1). In another report (Barker, 1989), "teleteachers" indicated their concern with distance, since it made one-to-one communication more difficult.

Instructors should not point the camera on themselves and expect to generate student participation. Structuring student-teacher interaction in new ways, including appropriate teaching techniques and creating new opportunities for interactivity, is a crucial component to generating a positive student experience (Barker and Dickson, 1993; Massoumian, 1989; U.S. Office of Technology Assessment, 1989). The development of an appropriate distance teaching pedagogy could produce, in addition to teacher-student interaction, an opportunity for student-student interaction across multiple sites. This in turn would generate an environment in which technology itself becomes secondary to the exchange of ideas.

EXPANDING OPPORTUNITIES FOR INTERACTIVITY

The recommendations listed below could prove helpful to instructors as they prepare to teach through the use of two-way audio and video.

The T.V. Myth

During the first few class sessions, instructors observe that students are shy and intimidated by the technology. When seeing themselves on the monitor, students make every effort to avoid eye contact and general presence. These initial perceptions and in-class responses could be the result of experiences and attitudes towards home television viewing. "Being on T.V." reflects the passive nature of television viewing in our culture. Instructors should take the opportunity, in the beginning of the class, to dispel the attitudes "I am on T.V., thus millions are watching me" and "watching means being passive." Pointing out to students that the technology is just a medium of communication, its sole purpose being to unite those at home and those at distant sites, can make students feel more comfortable and more inclined to participate. Instructors can then begin setting the stage for generating an interactive classroom environment.

Students and the Technological Logistics

Explaining to students how the technology works, preferably during the first class session, will also take some of their attention away from the technology. Students will question as to how the audio works, where the microphones might be located (if an open audio system), how the video operates, how the instructor controls the system, etc. Instead of allowing students to become consumed with all these questions and divert their attention from the subject matter, faculty can assist them by addressing the operational aspects of the system. Students can be invited to see the operational panel and explore the system from an instructional perspective.

The Power of the Camera

Instructors can utilize the student camera to generate "forced interaction". The camera is a powerful tool and when pointed toward students, can engage them to respond. Students may also become more attentive since the instructor could request their contribution to the subject matter at any time through the use of the camera.

The Ten-Times Rule

Instructors can ensure student interaction and participation by attempting, for a minimum of ten instances, to engage students during each class session. This can take place by asking questions, encouraging students to express their thoughts on the subject matter and by having students respond to comments made by other classmates. As a result, the instructor becomes actively engaged in promoting participation and communicates to the class that student participation is valued.

Students Utilizing the Technology

Integrating into course assignments a short in-class student presentation requires students to use the technology. Arranging for students to come into the "interactive class" and practice their presentations will make them realize that the operational/technical logistics are not as overwhelming as they might have initially seemed. This experience could prove helpful since it will make students feel more comfortable with the technology. Developing an increased comfort level encourages students to engage in the subject matter during class and appreciate the capabilities of the technology.

Inter-site Exchange Through Prepared Questions

Preparing questions prior to each class session which correspond to the scheduled subject matter provides a good strategy to engage students during class. Ensuring that the questions are directed at all sites will strengthen the cohesiveness among the sites. Requiring students to prepare similar questions about their reading material can also prove helpful in encouraging their participation.

Identifying the Talker(s)

Instructors may observe that though most students are hesitant to participate during class, there is always a student who for various reasons is engaged in the subject matter through in-class participation. Identifying that student and utilizing his/her responses in a way that generates a spill-over effect can help create an interactive environment. The "talker's" comments can be used to generate additional questions and make other students feel more comfortable. Instructors must be aware that the "talker," if not properly managed, may have a negative impact and dominate the class, thus discouraging others from participating.

Ensuring Technical Effectiveness

Though there will be times when some aspect of the system will not be fully operational due to technical reasons, instructors should check to ensure that such situations are truly out of their control and the control of those at their institution. Many institutions operating these systems often provide some technical support. Instructors should be aware of the general procedures utilized to connect the sites for class time. Instructors should allow for extra time before class to ensure that everything is functioning properly. If students observe repeated technical problems, they may become more intimidated by technology and less willing to engage in class discussions.

Reversing the Question

Students often direct to the instructor in-class questions on the subject matter. Before responding, instructors might choose to reverse the question to the home site or to the distant site, thus utilizing the question as an opportunity to generate interaction.

Providing Feedback

Instructors, after developing an interactive based learning environment, may find it helpful to ask their students to reflect on the transparency of the technology. Often, students will be surprised and react positively as to how secondary the technology has become in their learning experience. Reflecting on these experiences can strengthen student confidence in the system and allow them to concentrate on the positive aspects of the educational experience.

Site Exchange

Visiting the distant site and teaching from that site on numerous occasions reinforces the importance of distant site students to the entire class. Teaching from that site also serves as a way to better integrate these students into the group and can strengthen these students' level of participation.

CONCLUSIONS

The above ideas may be of help to instructors when confronted with student concerns about the uses of technology in their distance learning classes. As indicated above, the production of an interactive environment will divert student attention from technology and engage them in the subject matter. Engaging students in the learning process encourages them to feel involved and thus, maximizes their overall in-class experience. Many of these experiences could also carry into "traditional teaching" and strengthen the experiences of other students.

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CONCEIVING THE COMMONS: AN INTERDISCIPLINARY APPROACH TO ENVIRONMENTAL LITERACY

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INTRODUCTION

Whether encountered at the local, regional, or global level, environmental problems are complex and multifaceted. Commonly, however, they are approached from within single disciplinary perspectives—an approach that ignores many of their dimensions. The crisis of declining biological diversity in the tropical rainforest, for example, cannot be adequately assessed within the confines of the biological sciences alone, where the focus is on preservation of genetic diversity and the sustainability of ecosystems. Global politics, historical circumstances, and values and beliefs are all also relevant; knowledge of these areas is necessary for a complete understanding of the problem.

This paper describes a new effort at the University of Oklahoma to produce a *conversational* approach to environmental questions. "Conceiving the Commons" is an initiative to provide students with a series of related courses --a program of studies--that trains them to appreciate and blend together perspectives on the environment from the sciences and the humanities. Students will develop skills in specific fields related to environmental issues while remaining firmly grounded in an interdisciplinary outlook that enables them to be able to converse with experts in other disciplines.

On a broader scale, this effort will address the question of "environmental literacy" (Biological Sciences Curriculum Study, 1993; Risser, 1986). In his presidential address to the Ecological Society of America, Risser (1986) decried the lack of knowledge in the general public of ecological issues (e.g., ecosystem structure and function), and environmental issues (e.g., human population growth, pollution). Public ignorance of these issues is related to a general lack of biological literacy within the populace (Biological Sciences Curriculum Study, 1993).

Efforts will address the knowledge problem by using some of the techniques that have been suggested to address biological illiteracy. To become truly biologically literate, students must not only know how to read information given to them; they must also know how to obtain information themselves and how to judge its veracity. To accomplish these goals, the Biological Sciences Curriculum Study (1993) suggests that students participate in higher-order learning exercises—activities that stress the development of analytic, synthetic, and evaluative skills. The structure of the courses in the minor is rich in higher-order learning experiences which also stress student responsibility for their own learning.

A distinctive feature of the program is the wide variety of disciplinary backgrounds among the faculty members who have helped plan and will participate in teaching the various courses envisioned. Over a third of the participants are based in the humanities, compared to under a fifth in comparable programs at other universities (Jacobsen, 1990). The diversity of disciplines represented in the program exemplifies this faculty's belief that environmental problems can only be satisfactorily solved with interdisciplinary methods.

THE PROGRAM OF STUDIES

The project will unfold over three years. A series of core courses designed to serve as a minor in Interdisciplinary Perspectives on the Environment has already been established. The core program consists of the following course requirements and options:

1) Introduction to Interdisciplinary Perspectives on the Environment;

2) either Environmental Ethics (Philosophy) or History of Ecology and Environmentalism (History of Science);

3) either Science, Technology, and Public Policy or Environmental Policy and Administration (Political Science);

4) either Ecology and Environmental Quality (Botany) or Principles of Plant Ecology (Botany) or Principles of Ecology (Zoology); and

5) Practicum in Interdisciplinary Perspectives on the Environment.

COURSE DEVELOPMENT AND IMPLEMENTATION

The work has fallen into three phases—development of the interdisciplinary introductory course; development of the single-disciplinary courses; and development of the interdisciplinary practicum which will serve as a summary course.

Phase One

The first year of the project has been dedicated to planning and piloting the introductory course designed to acquaint students with interdisciplinary perspectives on environmental issues. The faculty understanding of interdisciplinarity goes beyond each instructor presenting his or her own specialty in the classroom. Instructors learned to integrate approaches from other disciplines through a weekly seminar held during spring semester, 1994. This is believed to be essential for preparing faculty to perform the collaborative intellectual labor necessary to achieve solutions to environmental problems. This collaborative effort is be modelled in the classroom, so that students will gain the same skills, in part by watching them performed.

In the summer of 1994, considerable effort was invested in gathering resource materials including developing a slide collection, purchasing videotapes, and establishing a bibliography and acquiring copies of popular, semi-popular, and specialized articles that address each of the case studies in the introductory course. The university provided office space and utilities to house the resource library and make it available to students. This resource center will be important not only for establishing an institutional location for this interdisciplinary program, but also for facilitating student research in the core courses.

In fall 1994, the introductory course was implemented. The course was designed to incorporate increasing levels of complexity into the learning process. In the early weeks of the term, the first case study dealt with ecosystem preservation by examining the issues of wolf reintroduction into Yellowstone National Park. An ecologist who has conducted research in Yellowstone since 1986 was in charge of the unit and discussed some problems the park is now experiencing with an apparent over-abundance of grazing animals. She then called upon the expertise of a science historian to discuss the history of park management.

A political scientist then discussed how the policy system for decision-making regarding national parks attempts to meet the combined goals of public service and ecosystem preservation. However, managing the ecosystem presents ethical questions regarding the role of long-term custodians of the area—the issues discussed by a philosopher. Students utilized group activities, as well as assigned readings and lecture information, to complete their final unit project. This project entailed a design for a museum display about wolves in Yellowstone.

As the course progressed, the faculty gradually "weaned" the students, encouraging them to apply with increasing independence the methods they had learned. Thus, the next two case studies on marine mammal protection and water use incorporated fewer lecture sessions and more group projects and independent learning and research activities. Faculty did not direct students' work, but rather played the role of consultants for their independent efforts.

Phase Two

The main focus of the second year of the project is to begin developing and implementing the discipline- oriented courses which are an integral part of the core program. After taking the introductory course, students learn more about the specific methods and concepts each discipline brings to bear on environmental issues. They will then in the summary practicum course bring these skills to bear on a "real world problem."

Phase Three

In the third year of the project, the sequence of disciplinary courses within the core program will be completed and project participants will design the senior summary course for this core program. Faculty will select a key regional issue that students can address in a practicum experience. This course will provide students with the opportunity to take the methods, concepts, and principles learned in their previous courses and apply them to a concrete environmental problem that is regional in scope. In the process, students will shift their focus from the national and global levels to the level of action in their community.

The practicum will return to the interdisciplinary framework offered in the introductory course. The class will be divided into four working groups, with each group reporting to the class as a whole, so that all students will be aware of the progress being made.

In light of their research and interaction, the class will then work on analyzing how the *conversations* among the perspectives developed an interdisciplinary point of view. Toward the end of the semester, the class will present a report to professionals working on the problem in a public manner—perhaps through mock testimony to a public commission.

The program envisioned is founded on the principle that the effort of understanding environmental issues--of *conceiving the commons*--demands a sensitivity to a multiplicity of approaches. Nowhere is this sensitivity more important than in the practical implementation of solutions to environmental problems—hence, the culminating experience laid out in the practicum. It is hoped that the program will provide a model for the kind of education that provides students an intellectually responsible way to meet the challenges of ecological crisis.

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ACTIVE LEARNING THROUGH LIVE TELEVISION: REFLECTIONS ON PRACTICE

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INTRODUCTION

Doing more with less means teaching more students with fewer faculty members. And, it is said, it can be accomplished easily through television. A single faculty member can reach an extraordinarily large number of students by teaching classes on television. That translates to large gains in credit hour production with minimal additional effort. So goes the conventional administrative wisdom.

Teaching by television has been the wave of the future for at least the past 40 years. But, now, new economic realities are forcing us into that future. Business officers tell dismal stories of reduced financial support for higher education extending into the next century. Already, it is said, the best of the nineties are over. So, faculty are forced to look at other ways of going about the tasks of teaching and learning. Is television really one of those ways? Or, will it turn out to be just another example of students paying more and getting less?

Increasingly, faculty members are being asked to teach their courses by television. Their experiences, however, have not been widely shared with the profession (Merrion, 1992). The purpose of this paper is to share reflections on this author's first experience teaching by live television and to describe how those experiences challenged the principles of active learning.

TELEVISED INSTRUCTION

A scan of the literature on the effectiveness of televised instruction quickly brought discouragement. Smith (1989) summed up the empirical evidence with his conclusion that television "is not a good teaching tool" (Smith, 1989, p. 10). He wrote that the brain waves of viewers are just like those of people in light sleep and viewers forgot 80 percent of the content in just a few hours. This certainly did not inspire confidence in someone preparing to teach by television for the first time.

Others, fortunately, saw it differently. Russell (1992) insisted that students learn equally as well from televised classes as from any other means of delivery, including face-to-face classroom instruction. Merrion (1992), a college instructor who enrolled in a televised introductory theater course, reported on her experience and concluded, "I found it possible to have a first-rate educational experience through interactive television" (Merrion, 1992, p. 340).

Active Learning

"Interactive" seemed to be the key word associated with "television" in references to instruction at the college level. Ever since Alexander Astin (1985) introduced his theory of student involvement, active learning has become the norm in many college classrooms. Defined by Bonwell and Eison (1991) as "anything that involves students in doing things and thinking about the things they are doing" (Bonwell & Eison, 1991, p.2), active learning has altered the way many instructors do things. No longer are they satisfied with lecturing. Now they use a wide variety of instructional strategies aimed at active participation by students. Group discussions, role playing, student reports, case studies, and field trips are but some of the ways that student participation is encouraged. Student activity, rather than teacher activity, has become the focus of each class session.

Effectiveness, then, required television to be used as a tool for getting students active. That was the challenge set for this course: turn passive TV watchers into active learners. Encouragingly, Fisch and McCann (1993) reported that television was able to "elicit active participation and discourse in mathematics..." (Fisch & McCann, 1993, p. 108) among 8-12 year-old viewers of Square One TV. But, their finding seemed rare and unusual. More familiar were the claims that television encouraged passivity (Meyers & Jones, 1993), and was perceived by many to be *shallow* and *easy* (Clark, 1983).

GETTING CAMERA READY

Morrison (1993) reported that the growing number of colleges looking to deliver instruction by television will mean more intense competition for students, markets, channels, and broadcast licenses. Morrison also predicted that "television professors" would be groomed for media star or celebrity status.

This author experienced no sense of being groomed for stardom with his course. Actually, no one seemed to care if instructors had any skills for teaching by television or not. The only orientation provided was some passing advice not to wear white shirts or checked coats on camera.

The Classroom

The first look at the assigned studio classroom was frightening. Clearly designed for lecturing, it had fixed seating with a "set" at the front of the room for the professor. The "set" was much like what would be expected for a TV news anchor. The "desk" was a well-lighted focal point and had a TV monitor built into it, a small unobtrusive microphone extending from the top surface, a computer terminal neatly tucked away at the side, and a small panel of buttons for remote control of the cameras.

There was no question that the professor was supposed to sit in one spot and pontificate. These were surroundings that made difficult the engagement of students in lively discussion. A room change was requested, and granted. The new studio was one in which students sat in a circle and the instructor moved about freely.

THE COURSE AND STUDENTS

The course to be delivered by live television was EDLP 730, Higher Education in America, a course designed as an introductory survey course on the history of higher education for graduate students in higher educational administration and in social work degree programs. At least two sections of the course were typically offered each semester. This semester, however, only one section was offered giving students no choice but to take the course by television.

The delivery system was one that allowed for one-way video with two-way audio. It was interactive in the sense that viewers were connected by telephone to the studio classroom. Two-way video would be more interactive because the students could be seen and heard, but such a system may be too expensive for most colleges. Communicating by telephone was more active than simply watching television, so the conceptualization of the course was reworked so that it was viewed more as a telephone course than a television course. The television part was seen as nothing more than a visual aid.

Each class session began with an invitation for students to share with the class what they had learned, what questions they had encountered, or what interesting observations they had made since the last meeting. It was an open invitation for students to talk. And some did.

Each student was assigned to make an oral report of not more than five minutes in length. This was to ensure that everyone contributed to the content of the course. The time limitation turned out to be very important. In live television, time was everything; the class had to begin precisely on time and end the same way. No late starts or quitting early.

The Students

Thirty-nine students were enrolled, and of these, 31 were women. Eleven were doctoral students, the rest were studying for master's degrees. Most were in their mid to late twenties, although the doctoral students were in their thirties and forties. All but three of the students held graduate assistantships or were employed full-time in various administrative or faculty positions in colleges and universities in the region. So, most had work experience in higher education institutions and could speak from that experience in class discussion.

STUDENT REACTIONS

Early in the semester, students were asked to complete a formative evaluation instrument, specifically, *What Needs Improvement*, developed by Weimer, Parrett, and Kerns (1988). This gave them the opportunity to indicate if they were experiencing problems with the instruction, and what suggestions they might have for improvement.

Only a quarter of the students returned the questionnaires, but those that did had a message: they felt limited and inhibited in the class discussions. As one put it, "I'm afraid to say much because I don't want to say anything stupid--then its on TV and recorded." This was the same reaction as noted by Lacina and Book (1991), who found students to be inhibited by the lights and cameras, afraid of embarrassment, and feeling a need to think carefully before making comments.

End of Course Evaluations

The evaluation form distributed to students at the end of the course was a locally developed Course and Teacher Evaluation form normed for use by all instructors within the College of Education at the University of South Carolina. This same form had been used when the course was taught in the traditional way during previous semesters. It used a five-point Likert scale that ranged from "strongly disagree" (1) to "strongly agree" (5). The 32 items were divided into four subscales. The first related to methods of instruction, the second to fairness, the third to facilitation of learning, and the fourth to clarity of instruction.

Overall, the evaluations from the students were somewhat lower than those received during previous semesters. Ratings for items related to "methods of instruction" were the lowest; where usually scores received averaged 4.4, they now were 4.2. Ratings for "facilitation of learning" and "clarity of instruction" were somewhat better at 4.4, but still below the 4.5 typically received for this course. Items related to "fairness" were rated at the same 4.5 level as when the course was taught in the traditional manner.

Students were also surveyed to determine how free they felt to express themselves and to actively participate in the class. Most

(78%) said they felt comfortable speaking in class. However, they were guarded in what they said. A majority (53%) reported that "The television format inhibited the free expression of opinions". Apparently, the students sensed that classroom privacy was not as strong in a televised format and would not provide the level of safety found in the traditional classroom. As Duning et al. (1993) observed, this is "one of the most emotional and least discussed areas of resistance to telecommunications-based education" (Duning et. al., 1993, p. 21).

SUMMARY AND CONCLUSIONS

Summarizing this first experience of teaching by live television, it was clear that active participation is not easily obtained in the televised classroom. Students are intimidated by the cameras and microphones. They hesitate to speak for fear of making a mistake and looking foolish for all to see and replay on videotape. Those who do speak are careful about what they say. This was not the best climate for a free and unhampered exchange of ideas.

Student evaluation of instruction was somewhat lower than received when the course was taught in the traditional classroom. This could give pause to any faculty member whose tenure, promotion, or salary decisions depend partly on student evaluation of instruction.

Televised courses allow for a much better use of visual aids, but active learning on the part of students becomes difficult to achieve. With the almost inevitable use of more televised instruction, the problems of student interaction and active learning will need a great deal more attention than they have been given so far. Otherwise, educators risk accusations of further diluting the quality and effectiveness of instruction in U. S. colleges and universities.

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